Submitted to the

Town of Dedham, Massachusetts

GLENWAY/HAMILTON AVENUE STUDY AREA

Final Report

April 2004

Prepared by:

Metcalf & Eddy

Metcalf & Eddy

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April 16, 2004

Mr. Paul G. Keane, P.E.
Commissioner
Town of Dedham Public Works
55 River Street
Dedham, MA 02026

Subject: Glenway/Hamilton Avenue Study Area
Final Report

Dear Mr. Keane:

We are pleased to submit two copies of the final report for the Glenway/Hamilton Avenue study area. This report summarizes the findings of the field investigations and hydraulic capacity analysis performed on the study area sewer system. Based on the findings of these investigations, a recommended plan to eliminate problems with sanitary sewer overflows and system back-ups in the future has been developed.

Should you have any have any questions or require additional information, please feel free to call.

Very truly yours,

Michael P. Hartford
Project Manager
Metcalf & Eddy, Inc.

cc: Mr. Tom Mahin, MADEP – Northeast Regional Office
Mr. Don St. Marie, MADEP – Boston

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EXECUTIVE SUMMARY

In April 2000, the town of Dedham authorized the borrowing of funds for two projects that were approved by the Department of Environmental Protection (DEP) for zero percent loans under the State Revolving Fund program. The two projects included a drainage capacity assessment for the Manor area of Dedham and a sanitary sewer overflow (SSO) investigation for both the Manor area and the Glenway/Hamilton Avenue area. However, in an effort to maximize the use of the funds for these projects, the town proposed combining the two projects into a single project since the study area, referred to as the Manor area, was common to both. This approach was subsequently approved by the DEP, and the town proceeded with the preparation of a loan application to include the proposed drainage capacity assessment and SSO investigation for the Manor area of Dedham as part of the same study.

For reporting purposes, the scope of work for the project was divided between two different areas of study: the Manor area and the Glenway/Hamilton Avenue area of Dedham. The focus of this report is on the investigation of the sewer system tributary to the East Brook Replacement Interceptor (EBRI), including the Glenway/Hamilton Avenue area. This includes sewer subareas E3-2, E4-1, E4-2, and E5. The purpose of this investigation was to identify the factors contributing to sanitary sewer overflows and system back-ups within the study area. Based on the findings of this investigation as well as previous investigations conducted by either the town or Metcalf & Eddy, a recommended plan to eliminate these problems has been developed for implementation by the town.

A separate report has been prepared for the investigation of the sewer and storm drain systems in the Manor study area.

FIELD INVESTIGATIONS

An extensive field investigation program was conducted to provide a comprehensive review of the condition of the existing sewers within the study area and to identify infiltration/inflow (I/I) sources and other structural defects in need of repair. The field investigation program included

both smoke testing and TV inspection of sewers not previously investigated by the town. To avoid duplicating efforts, M&E first conducted a review of previous sewer investigation work conducted within the study area.

Smoke Testing of Sewers

Prior to this study, the town had performed smoke testing of the sanitary sewers in subarea E3-2. Although this work did not identify any inflow sources, a total of 52 suspect inflow sources were identified. As part of this study, therefore, the sanitary sewers in the three remaining subareas (E4-1, E4-2, and E5) were smoke tested. This identified five inflow sources contributing approximately 23,300 gallons per day of peak inflow during the one-year, six-hour design storm event utilized by the DEP for inflow analyses. In addition, suspect inflow sources were identified at a total of 78 sites with multiple sources at a number of sites.

Television Inspection of Sewers

Prior to this study, the town had performed cleaning and TV inspection of approximately 30,800 feet of sewer throughout the study area. In an effort to completely inspect the sewers in the study area, cleaning and TV inspection of 27,100 feet of sewer was performed as part of this study. Of the 57,900 feet of sewer inspected, approximately 48,700 feet had observed defect(s) requiring rehabilitation to reduce I/I quantities and/or to extend the life of the existing sewer as a preventative measure. The total estimated infiltration identified from observed defects was approximately 40,800 gpd. Of this total, approximately 19,500 gpd of infiltration was contributed by defects in the mainline sewer and 21,300 gpd was contributed by service connections.

HYDRAULIC CAPACITY ANALYSIS

A hydraulic capacity analysis was conducted for all the sewers in the study area to identify the hydraulic limitations that may be adversely affecting the system during wet weather, peak flow conditions. As part of this effort, field survey was performed to acquire the necessary information on the study area sewers, including rim and invert elevations, pipe diameters, and pipe lengths, to complete the capacity analysis.

The capacity analysis identified numerous sewers in the study area which have been constructed at less than minimum slope. These sewers are more likely to have problems with sediment deposition and back-ups due to poor flow velocities. The analysis also highlighted where there is a potential for a bottleneck to exist under peak flow conditions that could restrict the flow conveyed via the downstream sewer. A number of sewers including those on Rustcraft Road, Hamilton Avenue, Glenway, and East Street are highlighted as areas having a history of maintenance problems, overflows, surcharges, and/or back-ups.

EVALUATION OF ALTERNATIVES

Based on the results of the field investigations and capacity analysis, alternatives available for sewer pipeline rehabilitation and for addressing capacity limitations within the study area sewers were identified and evaluated.

Sewer Pipeline Rehabilitation

For the purpose of this report, sewer pipeline rehabilitation is divided into three categories: sewer pipeline rehabilitation utilizing trenchless technologies, sewer replacement, and rehabilitation of lateral service connections. Sewer pipeline rehabilitation utilizing trenchless technologies is recommended for approximately 33,000 feet of sewer. This generally includes root control, joint testing and chemical sealing, spot repair of structural defects, or sewer relining. The total estimated cost of these sewer pipeline repairs is approximately $1,149,000.

Sewer replacement is recommended for approximately 2,970 feet of sewers with a total estimated cost of approximately $872,000. This work is exclusive of the recommended improvements to address sewer capacity problems as discussed in the paragraphs that follow.

Service lateral rehabilitation is recommended for approximately 120 services. Rehabilitation of service laterals includes cutting, sealing and testing, or digging and replacing. It is recommended that the cutting and sealing and testing of services be included as part of the trenchless sewer pipeline rehabilitation work. The total estimated cost for this work is approximately $164,000. It is also recommended that services requiring replacement be included as part of the sewer replacement work. The total estimated cost for replacing services is approximately $114,000.

Sewer Capacity Alternatives

The alternatives available to increase flow capacity generally include constructing either new replacement or relief sewers, identifying and removing private inflow sources, and implementing routine operation and maintenance (O&M) procedures. These alternatives would be in addition to any sewer rehabilitation work recommended above.

The existing sewer on Rustcraft Road going in either direction from the terminus of the East Brook Replacement Interceptor (EBRI) toward Elm Street or East Street is subject to flow related problems. To address the portion of the Rustcraft Road sewer between the EBRI and Elm Street, it is recommended that the town conduct a preliminary design study to evaluate the impacts and costs associated with construction of a new gravity replacement sewer versus a pump station and force main. The total estimated cost of this study is approximately $40,000.

To address the portion of the Rustcraft Road sewer between the EBRI and East Street, it is recommended that the town proceed with the bidding and construction of new sewers along Rustcraft Road, Glenway, and Hamilton Avenue. The total estimated cost of this project, including an allowance for engineering and contingencies, is approximately $975,000.

It is also recommended that the town develop an inflow reduction plan to address private sources of inflow such as sump pumps, roof leaders, and yard/driveway drains. To implement such a program, however, the town must first identify and evaluate the costs, funding, schedule, and legal and institutional issues associated with the removal of private sources of inflow.
To minimize the potential for flow related problems to occur within the study area sewers, it is recommended that the town implement a program of cleaning the sewers and inspecting the manholes for evidence of surcharging on a regular basis. As recommended in previous reports, the town should also take the necessary steps to locate and inspect any missing or buried manholes where information indicates that such a manhole exists. In addition, the town should provide and maintain access to all the sewers located in cross-country easements.

IMPLEMENTATION PROGRAM

The recommended plan consists of four components: sewer pipeline rehabilitation, sewer capacity improvements, town-wide program addressing private inflow sources, and routine O&M procedures for priority sewers within the study area. Table ES-1 presents a summary of the estimated capital costs for all components of the recommended program. The estimated costs are based on current construction prices and engineering costs as of May 2003, and are referenced to an Engineering News Record (ENR) Construction Cost Index of 6642. With the exception of the costs for the sewer replacement on Rustcraft Road, Glenway, and Hamilton Avenue, the costs presented in this table are planning level cost estimates for budgeting purposes only. A more accurate estimate of the anticipated construction costs may be determined during the design phase(s) of the recommended program.

It is anticipated that the funding required to implement the sewer pipeline rehabilitation program would be generated from the annual assessment of $500,000 that is added to the sewer rate by the town. This assessment was approved at 2001 Spring Town Meeting for this purpose. Although there is currently $530,000 available for I/I rehabilitation, a portion of this funding is already committed to miscellaneous repairs of the system. Since the total cost of the sewer pipeline rehabilitation program exceeds the funding available, a phased approach is proposed.

TABLE ES-1. SUMMARY OF ESTIMATED COSTS

Component	Total Estimated Cost
Sewer Pipeline Rehabilitation	
• Sewer Rehabilitation Utilizing Trenchless Technology	$1,149,000
• Sewer Replacement	$872,000
Lateral Service Connection Rehabilitation	
• Cutting and/or Sealing and Testing	$164,000
• Dig and Replace	$114,000
Sewer Capacity Improvements	
• Design Study of Rustcraft Road (Elm to McKinley Street)	$40,000
• Construction of New Sewers (Rustcraft Road, Glenway and Hamilton Avenue)	$975,000
Removal of Private Inflow Sources	N/C
Routine O&M	N/C
Total	$3,314,000

This would entail initiating the design of two separate contracts for sewer rehabilitation utilizing trenchless technologies and traditional dig and replace methods of construction. As additional funding becomes available from year to year, the town would then bid the contracts for construction.

The funding to conduct the design study for the existing sewer on Rustcraft Road from Elm Street to McKinley Avenue would be obtained from the various fees to be paid by JPI Apartment Development for the proposed "Dedham at Jefferson" project. For the proposed 300-unit apartment complex, the developer would be required to pay $150,000 in sewer connection fees and $64,000 in I/I mitigation fees.

The funding for the construction of new sewers along Rustcraft Road from McKinley Avenue to East Street, Glenway, and Hamilton Avenue has already been approved by the town through a Proposition 2-1/2 Override Vote conducted in June 2001. By way of this vote, the town is authorized to borrow up to $2.5 million for this project.

As a first step toward addressing private inflow sources, the town should organize an advisory group of town officials and residents to conduct a workshop meeting to discuss the various programs that have been used throughout the state. Following the workshop meeting, the town

should then develop an inflow reduction plan that meets the goals and objectives as determined by the advisory group. As part of this effort, the town should review its existing ordinances to ensure that the legal authority to implement the program is in place. The town should also sponsor public participation activities, including the preparation of a brochure to mail to residents, posting the brochure on the town's web site, and conducting a series of public meetings to inform residents of the program. Finally, the town should develop a standard set of details to specify the appropriate methods for redirecting private sources of inflow.

To implement a program of routine O&M procedures, the town should schedule the cleaning of sewers and inspection of manholes in areas subject to flow related problems on an annual basis to start. The schedule may then be adjusted accordingly based on the findings of the first several rounds of cleaning and inspection. For the most part, it is anticipated that this work could be performed utilizing town personnel and equipment.

SECTION ONE
INTRODUCTION

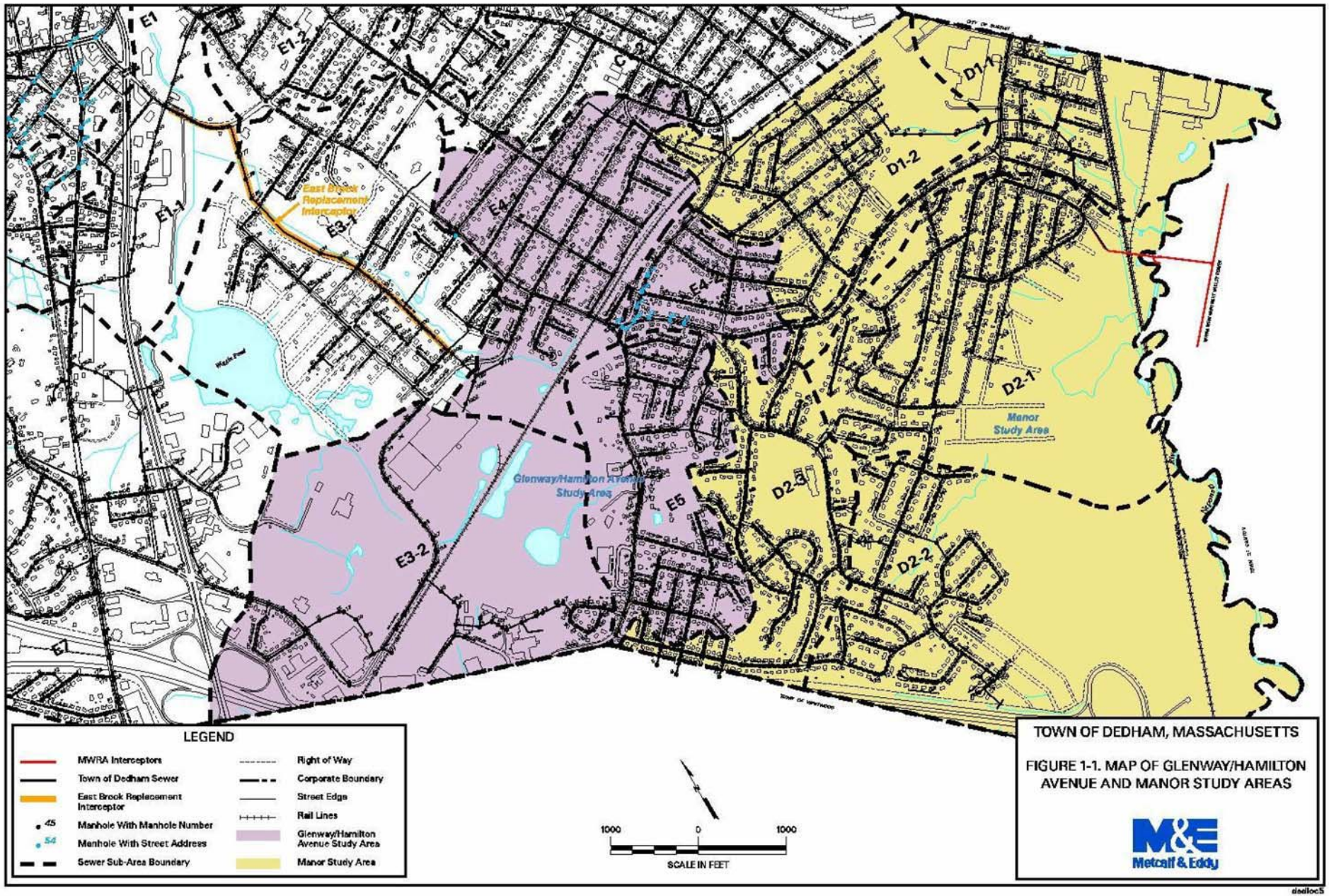
In April 2000, the town of Dedham authorized the borrowing of funds for two projects that were approved by the Department of Environmental Protection (DEP) for zero percent loans under the State Revolving Fund program. The two projects included a drainage capacity assessment for the Manor area of Dedham and a sanitary sewer overflow (SSO) investigation for both the Manor area and the Glenway/Hamilton Avenue area. However, in an effort to maximize the use of the funds for these projects, the town proposed to the DEP that the scope of work for the two projects be combined into a single project since the study area, referred to as the Manor area, was common to both. This approach was subsequently approved by the DEP, and the town proceeded with the preparation of a loan application to include the proposed drainage capacity assessment and SSO investigation for the Manor area of Dedham as part of the same study.

For reporting purposes, the scope of work for the project was divided between two different areas of study: the Manor area and the Glenway/Hamilton Avenue area of Dedham. Figure 1-1 shows the limits of each study area. The focus of this report is on the investigation of the sewer system tributary to the East Brook Replacement Interceptor (EBRI), including the Glenway/Hamilton Avenue area. The purpose of this investigation was to identify the factors contributing to sanitary sewer overflows and system back-ups within the study area. Based on the findings of this investigation as well as previous investigations conducted by either the town or Metcalf & Eddy, a recommended plan to eliminate these problems has been developed for implementation by the town.

A separate report has been prepared on the investigation of both the sewer and storm drain systems serving the Manor area of Dedham.

PROJECT AREA AND SCOPE

As shown on Figure 1-1, the Glenway/Hamilton Avenue study area is located in the southern section of Dedham and is comprised of sewer subareas E3-2, E4-1, E4-2, and E5. The sewers in


E1
E1-1
E1-2
E3-1
E3-2
E4
E5
D1-1
D1-2
D2-1
D2-2
D2-3
East Brook Replacement Interceptor
Manor Study Area
Glenway/Hamilton Avenue Study Area
LEGEND
MWRA Interceptors
Town of Dedham Sewer
East Brook Replacement Interceptor
45 Manhole With Manhole Number
54 Manhole With Street Address
Sewer Sub-Area Boundary
Right of Way
Corporate Boundary
Street Edge
Rail Lines
Glenway/Hamilton Avenue Study Area
Manor Study Area
1000
0
1000
SCALE IN FEET
TOWN OF DEDHAM, MASSACHUSETTS
FIGURE 1-1. MAP OF GLENWAY/HAMILTON AVENUE AND MANOR STUDY AREAS
Metcalf & Eddy
dedloc5

these subareas are tributary to the EBRI located along Fairbanks Road. In 1998, the town completed the construction of approximately 4,500 feet of the EBRI between Eastern Avenue and Fairbanks Road to eliminate surcharged conditions and sanitary sewer overflows to the East Brook during wet weather conditions and to reduce infiltration/inflow to the system. Although the replacement project was successful in eliminating these problems, there are two low-lying areas upstream of the EBRI that continue to experience problems with sanitary sewer overflows and system back-ups. Of the two areas, the Glenway/Hamilton Avenue area is the most prone to frequent overflows due to the low-lying topography and shallow depth of the existing sewers together with hydraulic limitations of the sewers on East Street and Rustcraft Road which ultimately convey the flow to the EBRI. Overflows can also occur further upstream in the system along East Street near Norwich Street which is another low-lying area where the system can relieve itself under extreme surcharged conditions.

The study area is mostly residential, however, a few pockets of commercial development exist. The sewer system in these four subareas is comprised of approximately 59,000 feet of gravity sewer ranging in size between 6- to 18-inches in diameter, constructed mostly of vitrified clay (VC) pipe.

The scope of work for this project included an extensive field investigation program involving both smoke testing and TV inspection of all sewers not previously investigated by the town. A hydraulic analysis was also performed for the entire sewer system within the study area to identify where capacity limitations may be adversely affecting the system during wet weather, peak flow conditions. Based on the findings of these investigations, a recommended plan to eliminate problems with sanitary sewer overflows and system back-ups in the future has been developed.

PREVIOUS STUDIES AND REPORTS

In the interest of both documenting previous work and facilitating the review of past results and data, the studies and reports prepared for the town by Metcalf & Eddy as listed below are summarized on the following pages.

- *Infiltration/Inflow Analysis*, April 1989, revised April 1994.
- *Sewer System Evaluation Survey*, July 1989, revised April 1994.
- *Letter Report for East Brook Interceptor Replacement Study,* January 1995.
- *Internal TV Inspection of Sewers*, September 1998.
- *Letter Report for TV Inspection of Sewers – December 1999/January 2000*, June 2000.

In addition to the reports noted above, the town has also implemented an annual program of TV inspecting approximately 40,000 feet of sewers. The goal of this program is to systematically inspect the condition of the entire sewer system for signs of infiltration/inflow and other structural defects that require subsequent rehabilitation.

The following is a summary of the work performed as well as the findings for each report as it relates to the study area being investigated.

1994 I/I Report

Essentially, the results of the 1994 reports establish the baseline conditions for subsequent I/I and sewer system evaluation survey (SSES) reports and investigations for the system. As part of the 1994 I/I report, continuous flow metering was conducted at 24 different locations across the town for a ten week period between April and June 1988. Instantaneous flow monitoring as well as rainfall gauging were also conducted as part of the data collection process. Results of the flow metering for the study area being investigated are shown in Table 1-1.

TABLE 1-1. COMPONENTS OF AVERAGE DAILY SEWAGE FLOW

Subarea	Ranking	Average Daily Dry Weather Sewage Flow (gpd)	Infiltration (gpd)	Average Daily Wastewater Flow (gpd)	% Infiltration of Average Daily Sewer Flow
E3-2	22	115,000	40,000	75,000	35
E4-1	8	261,000	180,000	81,000	69
E4-2	23	38,000	21,000	17,000	55
E5	17	100,000	64,000	36,000	64

The total amount of infiltration entering the system was estimated to be approximately 3,200,000 gpd. As shown in Table 1-1, the four subareas within the Glenway/Hamilton Avenue study area contributed approximately 305,000 gpd, or 10% of the infiltration to the system at the time of the investigations. The ranking shown for each subarea was based on comparison of the infiltration rates estimated for all 24 subareas throughout the system from the highest to the lowest infiltration rate.

As part of the I/I report, an inflow analysis was performed on a 14-hour storm event which occurred on April 28, 1988 when approximately 1.20 inches of rainfall was recorded. Three of the four subareas in the aforementioned study area showed sustained peak flows, indicating the presence of sump pump discharges. Those subareas were subareas E4-1, E4-2 and E5. Results of the inflow analysis for the study area are shown in Table 1-2.

TABLE 1-2. SUBAREA INFLOW SUMMARY

Subarea	Ranking	Municipal Sewer (inch-miles)	Design Storm (gpd)	Peak Inflow Rate (gpd/in-mile)
E3-2	3	21.9	232,000	10,600
E4-1	20	37.5	86,000	2,300
E4-2	24	17.1	30,000	1,800
E5	19	23.8	64,000	2,700

The ranking shown for each subarea was based on comparison of the peak inflow rates estimated for all 24 subareas throughout the system from the highest to the lowest inflow rate. Of the estimated 5,448,000 gpd of inflow entering the system during the one-year six hour design storm event, approximately 412,000 gpd of inflow, or 7.5% of the inflow to the system, was contributed by the subareas within the Glenway/Hamilton Avenue study area.

1994 SSES Report

Field work performed during the 1988 SSES investigation included physical survey mapping, manhole inspections, smoke testing, dyed water testing, dyed water flooding, house-to-house inspections, and a questionnaire survey. The investigations were conducted between March and August 1988 for a number of different subareas. No inspections were performed in subareas

E4-1, E4-2 or E5. The results from subareas E3-1 and E3-2 were combined into one subarea named E3.

A total of 1,148 manholes were located and inspected. Each inspection indicated whether or not the manhole exhibited infiltration (brickwork or joints leaking in manhole walls or bases) or inflow (defective frames, covers with holes, or deteriorated corbels). Of the subareas investigated as part of the SSES investigation, 42 manholes were identified as contributing approximately 143,500 gpd of infiltration to the system. In addition, 145 manholes were identified as contributing approximately 850,600 gpd of inflow to the system. In subarea E3, one manhole was identified as contributing approximately 2,200 gpd of infiltration to the system whereas ten manholes were identified as inflow sources contributing approximately 28,900 gpd of inflow.

Smoke testing was performed on a total of approximately 249,400 feet of sewers. The smoke test program identified both confirmed and suspect inflow sources. Following smoke testing, dye water flooding and testing were performed.

Confirmed sources such as driveway drains, area drains, or catchbasins which smoked during smoke testing were scheduled for dye water flooding. Confirmed roof leaders were not dye tested. A total of 32 locations were dye water flooded, 18 of which were confirmed as positive I/I sources contributing approximately 180,000 gpd of infiltration and 206,000 gpd of inflow. None of the positive sources contributing I/I were located in subarea E3.

Suspect inflow sources are either roof drains that discharge below ground or area drains that are in close proximity to the sewer but did not test positively during smoke testing. A total of 585 suspect sources were identified, of which 52 were located in subarea E3. Dye water testing was then performed for 127 suspect sources, including two suspect sources located in subarea E3. However, none of the suspect sources tested positive for dye. Therefore, dye water testing of the remaining 458 suspect sources was suspended.

House-to-house inspections were performed for approximately 1,228 basements and a total of 55 sump pumps, 70 basement drains, and 3 foundation drains were identified as discharging to the sewer system. Of the 93 basements inspected in subarea E3, a total of 2 sump pumps and 10 basement drains were identified as discharging to the sewer system.

1995 East Brook Interceptor Replacement Study Report

In January 1995, a letter report was submitted to the town summarizing the final results of a study performed for the East Brook Interceptor (EBI) between Eastern Avenue and East Street. At that time, the EBI had a history of maintenance problems including debris build-up, system surcharging, and sanitary sewer overflows. The sewer was also a significant source of infiltration/inflow.

As part of the study, a number of investigations were performed to determine the cause of the surcharging and overflows. A field survey was performed to collect manhole invert elevations which were used to determine the capacity of the sewer. Results from a preliminary subsurface investigation indicated that sags in the EBI were likely the result of poor soil conditions, making for an unsuitable foundation. Future flow for the area tributary to the EBI was estimated in an effort to properly size a replacement sewer. In addition, results from previous studies and inspection work, including TV inspection and I/I work, were also reviewed.

Based on the information reviewed and collected, three alternatives were developed for replacing the EBI. The first alternative entailed installing a gravity interceptor parallel to the EBI. The second and third alternatives were two different arrangements of a pump station, force main, and gravity sewer. As part of the report, advantages and disadvantages for each alternative were addressed as well as estimated construction costs and impacts to wetlands.

1998 TV Inspection Report

In April 1997, the town initiated a program to television inspect sewers in streets where roadway reconstruction was proposed by the town and/or the Massachusetts Highway Department.

Between April and November 1997, approximately 123,000 feet of sewers were inspected by either pulling a closed-circuit television inspection camera through the sewer pipeline or using a self propelled crawler camera to videotape the condition of the pipe from manhole to manhole. As part of this effort, the downstream end of the Lower Brook Interceptor (LBI), between Eastern Avenue and its terminus near Maverick Streets, was also TV inspected. The purpose of this inspection was to investigate the physical condition and structural integrity of the LBI downstream of the new replacement interceptor for the East Brook Interceptor.

The TV inspection logs and videotapes were subsequently reviewed by M&E to note defects and make recommendations to rehabilitate the aging sewer system. In addition, videotapes and logs for approximately 23,000 feet of sewer previously inspected by the town were reviewed to update and prioritize the recommended repairs to the system. The results of the report concluded that the defects identified were contributing approximately 560,000 gpd of infiltration to the sewer system. In order to reduce I/I quantities and improve system operation, a recommended program of sewer and manhole rehabilitation utilizing both trenchless technologies and traditional dig and replacement methods of construction, periodic operation and maintenance, and further investigations was developed. The total estimated cost of this program was approximately $9.6 million.

Based on review of this report, only portions of sewers in subareas E4-1, E4-2 and E5 had been television inspected, whereas almost all of the sewers in subarea E3-2 had been completed. By way of this investigation, the town had TV inspected approximately 30,800 feet of sanitary sewer in the Glenway/Hamilton Avenue study area. This represents a little more than 50 percent of the total study area which is comprised of approximately 59,000 feet of sanitary sewer.

2000 TV Inspection Report

Between December 1999 and January 2000, approximately 29,400 feet of sewer were cleaned and television inspected by the town. Based on these inspections, approximately 98,000 gpd of infiltration was observed to be entering the sewer system. Of the 29,400 feet of sewer inspected,

approximately 26,800 feet required repairs to rehabilitate observed defects and extend the life of the existing sewers as a preventative maintenance measure.

This report did not include inspection of sewers in subareas being addressed as part of this study.

Additional Investigations

Between October 2001 and May 2002, approximately 43,500 feet of sewer were cleaned and television inspected by the town. Based on these inspections, approximately 117,200 gpd of infiltration was observed to be entering the sewer system. Of the 43,500 feet of sewer inspected, approximately 36,000 feet required repairs to rehabilitate observed defects and to extend the life of the existing sewers as a preventative maintenance measure.

The sewers inspected during this program did not include sewers in subareas being addressed as part of this study.

REPORT ORGANIZATION

The organization and contents of the remaining sections of the report are discussed below.

Section Two of the report presents the findings of the field investigations including smoke testing and television inspection of sewers. The section approximates quantities of inflow to the sewer system while also recommending approaches to remove inflow from the system. This section also summarizes the results of the television inspection of sewers. Results from previous television inspections in the area have also been included in this section in order to provide a more comprehensive review of the condition of all the pipes in the study area.

Section Three of the report presents the results of a hydraulic capacity analysis performed for the entire sewer system within the Glenway/Hamilton Avenue study area. This section also discusses the factors contributing to sanitary sewer overflows and back-ups in specific areas of the system.

Section Four of the report presents an evaluation of alternatives that are available to the town to address both sewer rehabilitation and sewer capacity limitations within the study area. Specific recommendations to address the aforementioned problems are also presented together with estimated costs.

Section Five of the report presents a summary of the recommendations made based on the findings of the field investigation and hydraulic capacity analysis performed in this study. A discussion of the costs, funding, schedule, and legal and institutional issues associated with their implementation is also presented.

Although this report is intended to be comprehensive, some additional technical details and supporting materials may be found in the following interim letter reports which were prepared by Metcalf & Eddy during the course of the project.

	Interim Letter Report	Submittal Date
1.	Smoke Testing Results for the Manor and Glenway/Hamilton Avenue Study Area	December 29, 2000
2.	Television Inspection Results for the Manor and Glenway/Hamilton Avenue Study Area	August 27, 2002

The important aspects of these interim submittals have, in general, been condensed into this report. However, they are referenced in the text where further information is available to the interested reader.

SECTION TWO
FIELD INVESTIGATIONS

An extensive field investigation program was conducted as part of this study to provide a comprehensive review of the condition of the existing sewers within the Glenway/Hamilton Avenue study area. The field investigation program included both smoke testing and TV inspection of sewers not previously investigated by the town. To avoid duplicating past efforts, M&E first conducted a review of previous sewer investigation work conducted within the study area.

The goal of the field investigation program was to identify I/I sources and other structural defects in need of repair. These repairs may include efforts to reduce I/I quantities and to extend the life of the existing sewers as a preventative measure. Often times, there may be a more compelling reason for implementing sewer rehabilitation measures, such as structural defects that may eventually lead to a pipe collapse.

Although not included in the scope of this study, it has been reported that nearly all of the sewer and drain manhole structures located in the town of Dedham were opened and inspected as part of the work performed by others in developing the town's GIS system. Reference to this data is made for the interested reader to obtain additional information on the physical condition of sewer manholes located within the study area.

The following presents a summary of the work performed, results of the findings, and recommendations to address I/I sources and structural defects through subsequent sewer rehabilitation.

SMOKE TESTING OF SEWERS

Smoke testing of the sanitary sewers in subareas E4-1, E4-2, and E5 was conducted between October and November 2000 by Savin Engineers, P.C. An interim letter report summarizing the

findings of the smoke testing work was subsequently forwarded to the town in December 2000. The smoke testing results, including the results from previous smoke testing work performed by the town, are summarized in the following paragraphs.

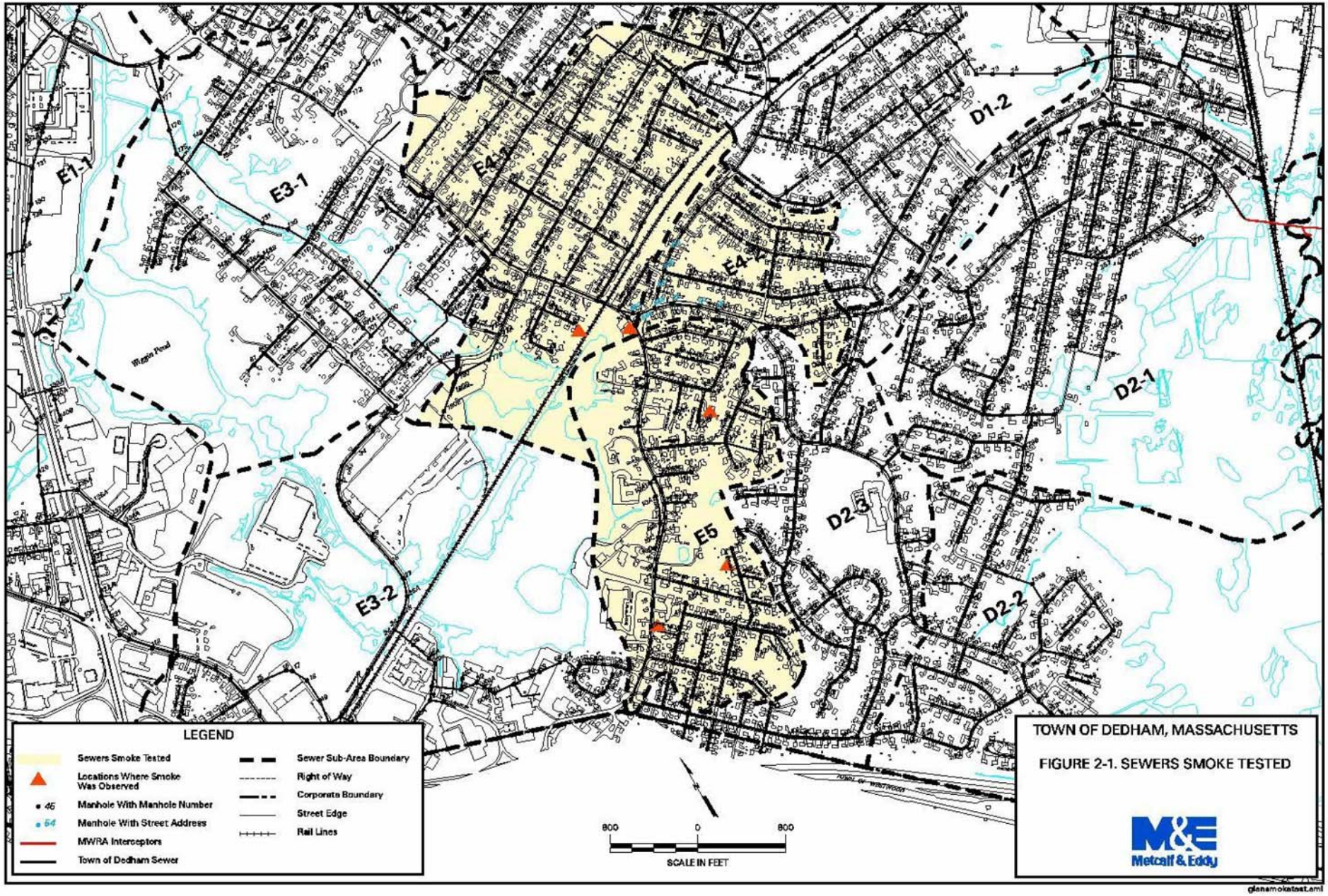
Previous Work

Based on review of the previous sewer investigation work conducted by the town, it was determined that the sewers in subarea E3 had been smoke tested as part of the 1988 SSES investigation. The results of this effort were summarized in the *Sewer System Evaluation Survey* report prepared by M&E dated July 1989 (revised April 1994). As noted in Section One of this report, there were no inflow sources identified by smoke testing. However, there were a total of 52 suspect inflow sources identified, of which two in subarea E3 were dye water tested and determined to be connected elsewhere.

Study Work

Figure 2-1 shows the subareas within the Glenway/Hamilton Avenue area where smoke testing was performed. A total of approximately 51,200 linear feet of sanitary sewer was smoke tested for the purpose of identifying sources of inflow. Table 2-1 summarizes the results of the smoke testing work. As indicated, a total of five inflow sources smoked during smoke testing of the sewers, including two driveway drains, one catchbasin, one water valve manhole, and one open pipe. The two driveway drains are located on private property and, as such, the property owners would normally be responsible for their removal. As is often the case, however, it may be difficult for the town to enforce this especially if an alternate discharge location, such as a storm drain, is not available. Since it is anticipated that the removal of private inflow sources will be an integral part of the recommended plan for this study, we would suggest at this time that the town initiate work on developing a program to address the removal of these sources in the future.

The catchbasin that smoked is located on Walters Avenue, and is considered a public inflow source. Accordingly, the town should take the steps necessary to have the catchbasin redirected.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E3-1
E4-1
E4
D1-2
D2-1
D2-3
E5
E3-2
D2-2
Wigwam Pond
LEGEND
Sewers Smoke Tested
Locations Where Smoke Was Observed
45 Manhole With Manhole Number
54 Manhole With Street Address
MWRA Interceptors
Town of Dedham Sewer
Sewer Sub-Area Boundary
Right of Way
Corporate Boundary
Street Edge
Rail Lines
800
0
800
SCALE IN FEET
TOWN OF DEDHAM, MASSACHUSETTS
FIGURE 2-1. SEWERS SMOKE TESTED
M&E
Metcalf & Eddy
glasmokatest.aml

TABLE 2-1. SUMMARY OF INFLOW SOURCES IDENTIFIED DURING SMOKE TESTING

Subarea	From MH	To MH	Location	Source	Estimated Peak Inflow [1] (gpd)	Estimated Inflow Volume [2] (gal)	Recommendation
E4-1	83	-	Glenway	Smoke from open 6" PVC pipe running from MH 83 to drainage swale area	[3]	[3]	Issue is being addressed as part of a sewer replacement contract to be constructed in the summer of 2003
E4-1	1	100	East Street	Smoke from MWRA water valve MH with tag, MET-WW-GV (77-55-A)	0	0	Issue referred to MWRA
E5	29A	29B	Walters Avenue	Smoke from CB in front of House #22	11,600	1,000	reroute CB
E5	36C	36B	Winstead Avenue	Smoke from driveway drain @ House #54	4,600	400	reroute drain
E5	38	20	East Street	Smoke from garage/driveway drain @ House #1112 on corner with Sidney Street	7,000	600	reroute drain
				Total =	23,200	2,000	

Notes:

(1) The peak inflow was calculated with the rational method using runoff design coefficients of 0.9 for asphalt and roof tops and 0.3 for grass and native soil,and a peak rainfall intensity of 0.87 inches/hour based on the one-year, six-hour design storm event.

(2) The inflow volume was calculated with the rational method using runoff coefficients of 0.9 for asphalt and roof tops and 0.3 for grass and native soil, and a total rainfall of 1.72 inches based on the one-year, six-hour design storm event.

(3) This pipe appears to act as an overflow relief outlet for the sewer on Glenway. Due to the relatively flat slope of the pipe, however, there is the potential for stormwater runoff to enter the sewer if saturated ground conditions existed and ponding of stormwater occured within the discharge swale.

However, as a first step, it may be worthwhile to conduct TV inspection of both the sanitary sewer and the storm drain to confirm whether a direct or indirect connection exists between the two pipes. Based on review of the field sketch, it would appear that the drain crosses over the sewer and connects to another catch basin located on the opposite side of the street. This would tend to suggest that an indirect connection may exist, such as a pipe defect allowing the smoke to travel from the sewer to the storm drain above.

The water valve manhole that smoked is connected to the MWRA's 36-inch water main on East Street at the Sprague Street rotary. On behalf of the town, M&E contacted the MWRA and requested that a field inspection of the manhole structure be completed. The MWRA subsequently inspected both the sewer and the water valve manhole, and determined that there was no cross-connection.

The open pipe that smoked is located at the end of Glenway. This pipe appears to act as an outflow relief outlet for the sewer on Glenway. In the event of surcharged conditions in the sewer (i.e., during wet weather, peak flow conditions), there is the potential for the sewer to overflow from MH 83 via the existing outlet pipe and discharge to a nearby drainage swale that drains naturally to the East Brook. However, since the existing outlet pipe is laid at a relatively flat slope with minimal cover (less than 12 inches), there is also the potential for stormwater runoff to enter the sewer at this location. For example, if saturated ground conditions existed and ponding of stormwater occurred within the drainage swale area, then the water could flow into the sewer via the existing open pipe. For this reason, therefore, the outlet pipe may be considered a potential source of inflow to the sewer system.

As of this writing, however, the town has developed plans to eliminate the aforementioned pipe as part of a proposed sewer replacement contract for the Glenway/Hamilton Avenue area. This work is tentatively scheduled to start construction in the summer of 2003. Under this proposed contract, the existing sewer on Glenway will be replaced, and the depth of the new sewer will be approximately 3.5 feet lower than the existing sewer. This will be accomplished by constructing a new larger diameter sewer on Rustcraft Road that extends from the terminus of the East Brook

Replacement Interceptor to East Street. Additional details of this proposed work is discussed further in Section Three of this report.

Using the rational method and runoff coefficients of 0.9 for asphalt/rooftops and 0.3 for grass/native soil, an estimate of the peak inflow (gallons per day) entering the sewer system was made for each inflow source identified, with the exception of the open pipe on Glenway. Assuming a peak intensity of 0.87 inches/hour from the one-year, six-hour design storm event, the total estimated flow contributed by the four sources is approximately 23,200 gpd. An estimate of the total volume of inflow (gallons) entering the system was also made for each direct inflow source using the same methodology as described above except the total rainfall (1.72 inches) from the one-year six-hour design storm event was multiplied by 0.623 (a constant to convert inches of rainfall to gallons per square feet). The total estimated volume of inflow contributed by the sources is approximately 2,000 gallons.

Table 2-2 lists those properties identified with suspect inflow sources such as driveway drains and/or roof leaders piped underground or to the foundation that did not smoke during smoke testing operations. Suspect inflow sources were identified at a total of 78 sites with multiple sources at a number of sites. These suspect sources could be dyed-water tested by the town to confirm the discharge location. Based on past experience, however, it is unlikely that a significant number of these sources would be confirmed as direct sources. Therefore, the town should consider the investigation of these sources a low priority.

TELEVISION INSPECTION OF SEWERS

Cleaning and TV inspection of approximately 27,100 feet of sanitary sewer located throughout the Glenway/Hamilton Avenue study area was performed by Severn Trent Pipeline Services, Inc. between October 2000 and March 2001. Follow-up TV inspection work was performed subsequently in February 2002 to address those sewers that could not be inspected originally due to surcharged conditions or access problems such as buried or paved over manholes. An interim report summarizing the findings of the television inspection work was forwarded to the town in

TABLE 2-2. SUMMARY OF SUSPECT INFLOW SOURCES IDENTIFIED DURING SMOKE TESTING

Subarea	House/Building #	Street	Suspected Source - Comments
D1-2	349	Cedar Street	Suspect roof leader
D1-2	30	Paul Street	Suspect roof leader
D1-2	64	Tower Street	Suspect roof leader
E4-1	170	Adams Street	Suspect driveway drain
E4-1	29	Boulevard Road	Suspect roof leader - in rear
E4-1	69	Boulevard Road	Suspect roof leader
E4-1	27	Circuit Road	Suspect roof leader
E4-1	35	Circuit Road	Suspect roof leader
E4-1	36	Dresser Avenue	Suspect roof leader
E4-1	782	East Street	Suspect roof leader
E4-1	789	East Street	Suspect roof leader
E4-1	795	East Street	Suspect driveway drain
E4-1	799	East Street	Suspect driveway drain
E4-1	827	East Street	Suspect roof leader
E4-1	59	Elmwood Avenue	Suspect driveway drain
E4-1	13	Ford Street	Suspect area drain
E4-1	16	Ford Street	Suspect area drain
E4-1	17	Ford Street	Suspect roof leader
E4-1	20	Ford Street	Suspect area drain
E4-1	24	Ford Street	Suspect driveway drain
E4-1	15	Glenway	Suspect roof leader
E4-1	21	Glenway	Suspect roof leader
E4-1	20	Greenwood Avenue	Suspect driveway drain
E4-1	27	Hamilton Avenue	Suspect roof leader
E4-1	64	Hamilton Avenue	Suspect roof leader
E4-1	92	Jefferson Street	Suspect roof leader - in rear
E4-1	120	Jefferson Street	Suspect driveway drain
E4-1	126	Jefferson Street	Suspect driveway drain
E4-1	158	Jefferson Street	Suspect roof leader
E4-1	179	Jefferson Street	Suspect roof leader
E4-1	204	Jefferson Street	Suspect driveway drain
E4-1	210	Jefferson Street	Suspect driveway drain
E4-1	159	Madison Street	Suspect roof leader
E4-1	165	Madison Street	Suspect roof leader
E4-1	218	Madison Street	Suspect roof leader
E4-1	354	Madison Street	Suspect roof leader
E4-1	79	Monroe Street	Suspect roof leader
E4-1	218	Monroe Street	Suspect roof leader
E4-1	106	Mt Vernon Street	Suspect roof leader
E4-1	316	Mt Vernon Street	Suspect roof leader
E4-1	178	Sanderson Avenue	Suspect roof leader
E4-1	21	Shiretown Road	Suspect roof leader
E4-1	42	Shiretown Road	Suspect roof leader
E4-1	18	Woodland Road	Suspect driveway drain
E4-2	42	Beech Street	Suspect roof leader
E4-2	393	Cedar Street	Suspect roof leader
E4-2	422	Cedar Street	Suspect roof leader
E4-2	431	Cedar Street	Suspect roof leader
E4-2	453	Cedar Street	Suspect roof leader
E4-2	36	Dresser Avenue	Suspect roof leader

TABLE 2-2. SUMMARY OF SUSPECT INFLOW SOURCES IDENTIFIED DURING SMOKE TESTING

Subarea	House/Building #	Street	Suspected Source - Comments
E4-2	37	Dresser Avenue	Suspect roof leader
E4-2	19	Kimbal Road	Suspect roof leader
E4-2	83	Kimbal Road	Suspect roof leader
E4-2	88	Kimbal Road	Suspect roof leader
E4-2	15	Nobel Road	Suspect roof leader
E4-2	88	Sprauge Street	Suspect driveway drain
E4-2	94	Sprauge Street	Suspect roof leader
E4-2	106	Sprauge Street	Suspect roof leader
E4-2	124	Sprauge Street	Suspect roof leader
E4-2	125	Sprauge Street	Suspect roof leader
E4-2	18	Taylor Avenue	Suspect roof leader
E5	30	Chester Avenue	Suspect roof leader
E5	Church near Preston Street	East Street	Suspect area drain
E5	43	Overlook Avenue	Suspect roof leader
E5	16	Pine Grove Avenue	Suspect roof leader and driveway drain
E5	38	Preston Street	Suspect driveway drain
E5	4	Ridgeway Street	Suspect driveway drain
E5	51	Ridgeway Street	Suspect roof leader
E5	24	Top Hill Avenue	Suspect driveway drain
E5	25	Top Hill Avenue	Suspect driveway drain
E5	27	Top Hill Avenue	Suspect driveway drain
E5	33	Top Hill Avenue	Suspect driveway drain
E5	47	Top Hill Avenue	Suspect roof leader
E5	29	Upland Road	Suspect roof leader
E5	17	Walters Avenue	Suspect roof leader
E5	24	Walters Avenue	Suspect roof leader
E5	11	Winfield Street	Suspect driveway drain
E5	31	Winstead Avenue	Suspect driveway drain

August 2002. The TV inspection results, including the results from previous TV inspection work, are summarized in the following paragraphs.

Previous Work

Based on review of the previous sewer investigation work performed by the town, it was determined that approximately 30,800 feet of sanitary sewer located throughout the Glenway/Hamilton Avenue study area had been TV inspected as a result of past work. The results of these efforts were summarized in a report titled *"Internal TV Inspection of Sewers,"* prepared by M&E dated September 1998. As noted in Section One of this report, only portions of the sewers in subareas E4-1, E4-2, and E5 had been TV inspected, whereas almost all of subarea E3-2 had been completed. One of the primary objectives of the field investigation program for this study, therefore, was to complete the TV inspection of the remaining sewers in the Glenway/Hamilton Avenue study area and to provide the town with a comprehensive review of the overall system condition. For completeness, the results from previous TV inspection work conducted within the study area by either the town or Metcalf & Eddy have also been incorporated in this report.

Study Work

Internal TV inspection, including light and some moderate/heavy cleaning, of approximately 27,100 feet of sewer was conducted as part of this study. The purpose of conducting this work was to visually inspect the physical condition of the sewers that had not been previously investigated by the town and to identify infiltration sources and defects within the system.

Prior to TV inspection, each sewer segment was cleaned using a high velocity jet rodder. As shown on Table 2-3, approximately 1,640 feet of sewer required moderate/heavy cleaning to remove heavy accumulations of sediment and debris material and/or grease build-ups. The remainder of the sewers only required light cleaning. Internal TV inspection was then accomplished by either pulling a small closed-circuit television camera through the sewer

TABLE 2-3. SEWERS REQUIRING MODERATE/HEAVY CLEANING

Sewer Subarea	From MH	To MH	Street Name	Pipe Diameter (in)	Pipe Length (ft)	Type of Cleaning Required
E4-1	53	56	Adams Road	8	280	Moderate
E4-1	98	99	East Street	12	225	Heavy
E4-1	56	56.1	Shiretown Road	8	254	Moderate
E4-2	6	7	Tower Street	8	248	Moderate
E4-2	16	19	Beech Street	8	101	Moderate
E4-2	20	21	Beech Street	8	192	Moderate
E5	50	49	Ridgeway Street	8	243	Moderate
E5	48	48A	Creston Avenue	8	98	Moderate
Total					1,641	

pipeline or by using a self-propelled crawler camera while videotaping the condition of the pipe from manhole to manhole.

Defects within the sanitary sewers, such as structural problems, inflow/infiltration, root intrusion, and grease build-up were recorded on logs for each manhole-to-manhole reach. Other observations, including longitudinal cracking of pipes, misaligned or broken joints, and break-in service laterals were also noted. Table 2-4 presents a summary of the infiltration sources and structural defects identified through TV inspection of most all the sewers in the Glenway/Hamilton Avenue study area. The table is organized by subarea and alphabetically by street name. Figure 2-2 highlights the sewers identified with defects throughout the study area, including those sewers identified as having service connections with defects.

By way of this investigation, the town has TV inspected approximately 57,900 feet of sanitary sewer in the Glenway/Hamilton Avenue study area. Of this total, approximately 9,200 feet of sewer did not have any observed defects. The remaining 48,700 feet had observed defect(s) requiring rehabilitation to reduce I/I quantities and/or to extend the life of the existing sewers as a preventative measure.

TABLE 2-4. SUMMARY OF SEWER PIPELINE DEFECTS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Pipe							Services				
								Debris	Leak in Pipe	Offset/ Open Joint	Cracked/ Broken Pipe/Jt	Evidence of Leakage	Roots	Est. Leak (gpd)	Broken/ Cracked	Break -in Conn.	Roots	Min Depos/ Leak	Est. Leak (gpd)
E3-2	2	40	39A	Allied Drive	95	12	none												
E3-2	2	41	40	Allied Drive	212	12	none												
E3-2	2	42	41	Allied Drive	132	12	none												
E3-2	1	43	42A	Allied Drive	298	8	minor				x		x						
E3-2	5	49	49.1	Allied Drive Easement	85	10	major												
E3-2	1	50	49	Allied Drive Easement	141	12	none												
E3-2	1	51	50A	Allied Drive Easement	60	12	none												
E3-2	1	59	67	Allied Drive Easement	131	8	minor			x			x						
E3-2	1	67	68	Allied Drive Easement	60	10	none												
E3-2	1	68	69	Allied Drive Easement	198	12	none												
E3-2	1	69	70	Allied Drive Easement	78	12	none												
E3-2	1	70	71	Allied Drive Easement	184	12	minor				x								
E3-2	1	71	51	Allied Drive Easement	198	12	none												
E3-2	1	39A	39	Allied Drive Easement	182	12	none												
E3-2	1	50A	50	Allied Drive Easement	97	12	none												
E3-2	1	1	2	Elm Street	193	8	minor			x			x			x			
E3-2	1	2	3	Elm Street	169	8	minor			x	x								
E3-2	1	3	4	Elm Street	169	8	minor			x						x			500
E3-2	1	4	5	Elm Street	169	8	minor			x						x			1,000
E3-2	1	6	5	Elm Street	49	8	none												
E3-2	1	7	6	Elm Street	198	8	none												
E3-2	2	8	7	Elm Street	246	8	minor								x		x		
E3-2	2	8	9	Elm Street	95	8	none												
E3-2	2	5	5A	Elm Street Easement	32	8	incomplete												
E3-2	2	16	17	Elm Street Easement	111	12	none												
E3-2	2	5A	15A	Elm Street Easement	220	8	incomplete												
E3-2	1	10	6	Robinwood Road	252	8	minor			x						x			500
E3-2	1	11	10	Robinwood Road	293	8	minor						x			x			500
E3-2	1	12	11	Robinwood Road	180	8	minor			x			x			x			
E3-2	1	13	12	Robinwood Road	270	8	minor			x			x			x			500
E3-2	1	14	13	Robinwood Road	52	8	none												
E3-2	2	20	22	Rustcraft Road	280	12	none												
E3-2	1	21	20	Rustcraft Road	102	12	none												
E3-2	2	22	23	Rustcraft Road	192	12	minor				x								
E3-2	2	23	24	Rustcraft Road	368	12	none												
E3-2	1	24	24A	Rustcraft Road	108	12	none												
E3-2	2	26	26A	Rustcraft Road	160	12	none												
E3-2	2	27	28	Rustcraft Road	233	12	moderate												
E3-2	2	28	29	Rustcraft Road	233	12	none												
E3-2	2	29	30	Rustcraft Road	233	12	none												

TABLE 2-4. SUMMARY OF SEWER PIPELINE DEFECTS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Pipe							Services				
								Debris	Leak in Pipe	Offset/ Open Joint	Cracked/ Broken Pipe/Jt	Evidence of Leakage	Roots	Est. Leak (gpd)	Broken/ Cracked	Break -in Conn.	Roots	Min Depos/ Leak	Est. Leak (gpd)
E3-2	2	30	31	Rustcraft Road	176	12	none												
E3-2	2	31	32	Rustcraft Road	175	12	none												
E3-2	2	32	33	Rustcraft Road	175	12	none												
E3-2	2	33	34	Rustcraft Road	161	12	none												
E3-2	2	34	35	Rustcraft Road	248	12	minor		x		x		x	180					
E3-2	2	35	36	Rustcraft Road	187	12	minor		x					1,440					
E3-2	1	24A	26	Rustcraft Road	174	12	none												
E3-2	2	26A	27	Rustcraft Road	174	12	moderate				x-sag								
E3-2	1, 2	17	18	Rustcraft Road Easement	263	12	none												
E3-2	1	18	19	Rustcraft Road Easement	303	12	none												
E3-2	1	19	19A	Rustcraft Road Easement	161	12	none												
E3-2	1	19A	20	Rustcraft Road Easement	54	12	none												
E3-2	1	55	56	Willard Street	113	8	minor									x			
E3-2	1	56	57	Willard Street	246	8	minor		x					500		x			500
E3-2	1	57	58	Willard Street	94	8	minor		x							x			100
E3-2	1	58	59	Willard Street	46	8	none												
E3-2	1	59	60	Willard Street	48	8	minor									x			
E3-2	1	60	61	Willard Street	75	8	none												
E3-2	1	61	62	Willard Street	72	8	minor				x								
E3-2	1	62	63	Willard Street	151	8	minor									x			
E3-2	1	63	64	Willard Street	64	8	minor						x						
E3-2	1	64	65	Willard Street	72	8	minor		x		x		x	250					
E3-2	1	65	66	Willard Street	122	8	none												
E4-1	5	47	48	Adams Street	145	8	minor						x			x	x		
E4-1	5	48	49	Adams Street	123	8	minor			x			x			x	x		
E4-1	5	49	53	Adams Street	250	8	moderate				x		x		x		x	x	180
E4-1	5	53	53.1	Adams Street	92	8	moderate				x								
E4-1	5	56	53.1	Adams Street	194	8	minor			x							x		
E4-1	5	80	81	Adams Street	221	8	moderate				x		x				x		
E4-1	1	81	82	Adams Street	267	8	moderate		x	x	x	x	x	250		x			
E4-1	5	89	90	Adams Street	220	8	incomplete			x						x	x		
E4-1	5	90	91	Adams Street	280	8	minor						x				x	x	180
E4-1	5	6	7	Boulevard Road	274	8	minor				x		x				x		
E4-1	5	7	8	Boulevard Road	278	8	moderate				x		x			x	x	x	360
E4-1	1*	8	9	Boulevard Road	269	8	moderate						x			x			
E4-1	1	9	5	Boulevard Road	262	8	minor												
E4-1	5	27	25	Circuit Road	297	8	minor									x			
E4-1	5	27	30	Circuit Road	284	8	minor								x				
E4-1	5	30	32	Circuit Road	283	8	minor		x				x	360		x	x		
E4-1		1	100	East Street	195	12	minor			x		x				x			

TABLE 2-4. SUMMARY OF SEWER PIPELINE DEFECTS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Pipe							Services				
								Debris	Leak in Pipe	Offset/ Open Joint	Cracked/ Broken Pipe/Jt	Evidence of Leakage	Roots	Est. Leak (gpd)	Broken/ Cracked	Break -in Conn.	Roots	Min Depos/ Leak	Est. Leak (gpd)
E4-1	1	3	4	East Street	234	8	minor			x			x						
E4-1	1*	4	4A	East Street	18	8	none												
E4-1	1	5	10	East Street	211	8	none												
E4-1	1	10	11	East Street	212	8	minor			x	x								
E4-1	1	23	11	East Street	178	10	none												
E4-1	1	44	23	East Street	180	10	minor				x					x			
E4-1	1	44	45	East Street	178	12	minor			x	x								
E4-1	5	45	46	East Street	156	10	minor			x		x							
E4-1	5	79	46	East Street	285	12	moderate			x	x		x				x		
E4-1	1*	82	79	East Street	76	12	none												
E4-1	5	98	99	East Street	225	12	minor	x								x			
E4-1	1*	98	82	East Street	346	12	moderate												
E4-1	1	99	100	East Street	205	12	none												
E4-1	5	882	99	East Street	101	12	none												
E4-1	1	4A	5	East Street	90	8	minor			x									
E4-1	1	41	70	Elmwood Avenue	336	8	minor			x			x			x			
E4-1	1	42	41	Elmwood Avenue	258	8	minor			x			x			x			50
E4-1	1	92	91	Elmwood Avenue	242	8	major			x	x		x			x			
E4-1	1	93	96	Elmwood Avenue	175	8	moderate			x	x		x			x	x		
E4-1	1**	93	91	Elmwood Avenue	174	8	moderate			x	x		x				x		
E4-1	5	31	30	Fales Road	204	8	minor									x	x		
E4-1	5	74	73	Ford Street	232	8	minor			x	x		x			x	x		
E4-1	5	75	74	Ford Street	51	8	minor						x						
E4-1	5	76	75	Ford Street	122	8	none												
E4-1	1	84	83	Glenway	265	8	incomplete												
E4-1	1**	67	66	Grant Avenue	282	8	minor			x	x		x			x			
E4-1	1**	94	95	Grant Avenue	245	8	minor			x	x		x			x	x		
E4-1	1**	95	96	Grant Avenue	247	8	minor			x			x						
E4-1	1**	96	97	Grant Avenue	255	8	minor				x						x		
E4-1	5	97	98	Grant Avenue	271	8	minor						x						
E4-1	1	26	99	Greenwood Avenue	176	8	none												
E4-1	5	26A	26	Greenwood Avenue	308	8	moderate				x		x			x			
E4-1	1	84	79	Hamilton Avenue	270	8	minor												
E4-1	1	85	84	Hamilton Avenue	236	8	moderate												
E4-1	1	86	85	Hamilton Avenue	74	8	minor												
E4-1	1	87	86	Hamilton Avenue	199	8	minor												
E4-1	5	58	57	Jefferson Street	100	6	incomplete					x-tubercu							
E4-1	5	58	60	Jefferson Street	315	8	minor		x				x	180		x	x	x	1,080
E4-1	5	60	61	Jefferson Street	309	8	moderate			x	x		x						
E4-1	5	61	62	Jefferson Street	308	8	minor		x				x	360					

TABLE 2-4. SUMMARY OF SEWER PIPELINE DEFECTS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Pipe							Services				
								Debris	Leak in Pipe	Offset/ Open Joint	Cracked/ Broken Pipe/Jt	Evidence of Leakage	Roots	Est. Leak (gpd)	Broken/ Cracked	Break -in Conn.	Roots	Min Depos/ Leak	Est. Leak (gpd)
E4-1	1*	62	68	Jefferson Street	221	8	minor						x						
E4-1	1*	68	69	Jefferson Street	210	8	minor												
E4-1	1*	69	70	Jefferson Street	210	8	none												
E4-1	1	70	71	Jefferson Street	212	8	minor			x			x						
E4-1	1	71	72	Jefferson Street	212	8	moderate			x			x			x			1,000
E4-1	1	72	46	Jefferson Street	213	8	moderate												
E4-1	5	24	59	Jefferson Street Easement	250	8	incomplete			x						x			
E4-1	5	58	59	Jefferson Street Easement	150	8	incomplete						x						
E4-1	5	54	53	Lilly Lane	285	6	incomplete					x-tubercu							
E4-1	5	54	55	Lilly Lane	292	6	minor	x								x	x		
E4-1	1*	25	24	Madison Street	285	8	minor												
E4-1	1	26	24	Madison Street	167	8	minor		x	x		x	x	500					300
E4-1	1	33	34	Madison Street	251	8	moderate			x	x		x			x	x		400
E4-1	1	34	35	Madison Street	234	8	moderate			x	x								
E4-1	1	35	36	Madison Street	221	8	minor				x		x			x			
E4-1	1	39	40	Madison Street	291	8	minor				x	x	x			x			
E4-1	1	40	41	Madison Street	293	8	major		x	x			x	2,930		x			2,880
E4-1	1	41	43	Madison Street	323	8	minor												
E4-1	1	43	44	Madison Street	322	8	minor				x		x			x			
E4-1	5	12	12.1	Madison Street Easement	50	8	minor		x					540					
E4-1	5	24	12.1	Madison Street Easement	302	8	minor		x				x	360					
E4-1	1	13	12	Monroe Street	180	8	moderate			x		x	x			x			
E4-1	1	14	15	Monroe Street	226	8	major			x			x			x	x		
E4-1	1	15	16	Monroe Street	228	8	moderate			x			x			x			
E4-1	5	16	19	Monroe Street	204	8	none												
E4-1	5	19	20	Monroe Street	233	8	minor						x			x	x		
E4-1	5	20	21	Monroe Street	232	8	minor									x			
E4-1	5	21	22	Monroe Street	280	8	minor									x	x		
E4-1	1	22	11	Monroe Street	273	8	minor												
E4-1	5	36	38	Mount Vernon Street	176	8	minor				x		x						
E4-1	5	38	62	Mount Vernon Street	167	8	none												
E4-1	5	63	62	Mount Vernon Street	203	8	minor				x		x			x			
E4-1	5	64	63	Mount Vernon Street	142	8	minor									x			
E4-1	5	65	64	Mount Vernon Street	261	8	minor									x			
E4-1	5	66	65	Mount Vernon Street	95	8	none												
E4-1	5	17	18	Mt. Vernon Street	283	8	minor				x								
E4-1	5	18	16	Mt. Vernon Street	282	8	minor						x			x			
E4-1	1	37	36	Mt. Vernon Street	120	8	moderate			x	x		x			x			1,000
E4-1	5	50	49	Netta Road	150	8	none												
E4-1	5	51	50	Netta Road	154	8	minor						x			x	x		

TABLE 2-4. SUMMARY OF SEWER PIPELINE DEFECTS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

								Pipe							Services				
Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Debris	Leak in Pipe	Offset/ Open Joint	Cracked/ Broken Pipe/Jt	Evidence of Leakage	Roots	Est. Leak (gpd)	Broken/ Cracked	Break -in Conn.	Roots	Min Depos/ Leak	Est. Leak (gpd)
E4-1	5	51	52	Netta Road	148	8	minor						x			x	x		
E4-1	2	46	73	Rustcraft Road	216	18	moderate												
E4-1	2	73	77	Rustcraft Road	193	18	moderate												
E4-1	2	77	77A	Rustcraft Road	198	18	none												
E4-1	2	77A	77B	Rustcraft Road	250	18	minor												
E4-1	2	77B	180	Rustcraft Road	314	18	moderate												
E4-1	5	1	2	Sanderson Avenue	307	8	moderate				x		x			x	x		
E4-1	1	2	3	Sanderson Avenue	313	8	minor			x			x			x			
E4-1	5	56	57	Shiretown Road	250	8	incomplete									x			
E4-1	5	27	28	Wood Road	122	8	minor						x						
E4-1	5	28	29	Wood Road	203	8	minor						x			x	x		
E4-2	5	16	19	Beech Street	101	8	none												
E4-2	5	17	16	Beech Street	230	8	none												
E4-2	5	18	17	Beech Street	208	8	moderate				x		x		x	x	x		
E4-2	5	19	20	Beech Street	194	8	minor				x					x			
E4-2	5	20	21	Beech Street	192	8	minor						x			x	x		
E4-2	5	21	28	Beech Street	191	8	moderate				x								
E4-2	5	28	stub	Cedar Street	130	8	incomplete	x											
E4-2	5	29	34	Cedar Street	246	8	major				x				x				
E4-2	5	29	28	Cedar Street	249	8	none												
E4-2	5	34	414	Cedar Street	217	8	major				x								
E4-2	1	414	425	Cedar Street	199	8	minor			x	x		x						
E4-2	1	425	441	Cedar Street	175	8	moderate			x	x	x	x			x			750
E4-2	1	441	455	Cedar Street	171	8	moderate												
E4-2	5	11	12	Dresser Avenue	195	8	moderate				x		x						
E4-2	5	12	13	Dresser Avenue	198	8	major				x		x				x		
E4-2	5	16	13	Dresser Avenue	242	8	moderate				x		x						
E4-2	5	14	15	Kimball Road	222	8	moderate				x					x			
E4-2	5	15	13	Kimball Road	222	8	moderate				x		x						
E4-2	5	22	13	Kimball Road	301	8	minor				x		x				x		
E4-2	5	23	24	Kimball Road	215	8	minor				x					x			
E4-2	5	24	29	Kimball Road	226	8	minor						x		x	x			
E4-2	5	35	36	Nobel Street	180	8	minor				x								
E4-2	5	36	37	Nobel Street	202	8	minor						x			x			
E4-2	1	32	455	Sprague Street	197	8	moderate			x	x					x			500
E4-2	5	37	38	Sprague Street	148	8	minor				x		x				x		
E4-2	5	37	39	Sprague Street	285	8	minor				x					x			
E4-2	5	39	40	Sprague Street	147	8	minor				x					x			
E4-2	5	40	41	Sprague Street	265	8	minor				x					x			
E4-2	5	41	66	Sprague Street	251	10	moderate		x				x	3,600		x	x	x	2,160

TABLE 2-4. SUMMARY OF SEWER PIPELINE DEFECTS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Pipe							Services				
								Debris	Leak in Pipe	Offset/ Open Joint	Cracked/ Broken Pipe/Jt	Evidence of Leakage	Roots	Est. Leak (gpd)	Broken/ Cracked	Break -in Conn.	Roots	Min Depos/ Leak	Est. Leak (gpd)
E4-2	5	50	32	Sprague Street	189	10	moderate		x		x			2,880	x	x		x	360
E4-2	1	66	50	Sprague Street	247	8	moderate			x	x		x		x	x			500
E4-2	1	455	884	Sprague Street	103	12	moderate			x	x								
E4-2	1	884	882	Sprague Street	104	12	none												
E4-2	5	10	11	Taylor Avenue	144	8	major				x		x						
E4-2	5	10	9	Taylor Avenue	311	8	moderate				x		x			x			
E4-2	5	24	25	Taylor Avenue	233	8	minor				x					x			
E4-2	5	25	26	Taylor Avenue	234	8	minor						x			x	x		
E4-2	5	26	27	Taylor Avenue	233	8	minor						x			x			
E4-2	5	27	425	Taylor Avenue	234	8	major				x		x			x			
E5	5	20B	20A	Alpena Avenue	276	6	minor				x								
E5	5	20C	20A	Alpena Avenue	101	8	minor						x			x			
E5	5	20D	20C	Alpena Avenue	227	8	major				x						x		
E5	1**	22	21	Chester Avenue	268	8	minor									x			
E5	5	21A	21	Chester Avenue	204	8	minor						x		x		x		
E5	5	21B	21A	Chester Avenue	205	8	moderate				x				x	x	x		
E5	5	39	39A	Creston Avenue	135	8	minor						x						
E5	5	48	38	Creston Avenue	202	8	minor				x					x			
E5	5	48	48A	Creston Avenue	98	8	minor						x						
E5	5	74.3	74.2	Cynthia Road	158	8	minor											x	
E5	5	74.3	74.4	Cynthia Road	84	8	none												
E5	5	74.4	74.5	Cynthia Road	246	8	minor											x	
E5	5	74.5	74.6	Cynthia Road	257	8	minor					x						x	1,080
E5	5	74.5	32	Cynthia Road Easement	220	8	none												
E5	1	3	4	East Street	263	12	moderate			x	x					x			
E5	1	4	5	East Street	109	12	minor		x	x	x								500
E5	1	6	7	East Street	201	12	major												
E5	1	7	8	East Street	167	12	minor												
E5	1	8	9	East Street	86	12	minor				x								
E5	1	9	10	East Street	177	12	minor									x	x		150
E5	1	10	11	East Street	129	12	minor									x			150
E5	1	11	12	East Street	126	12	minor					x				x			100
E5	1	12	13	East Street	127	12	minor									x			200
E5	1	13	14	East Street	126	12	moderate												
E5	1	14	15	East Street	262	12	major												
E5	1	15	16	East Street	98	12	minor				x		x						
E5	1	17	18	East Street	246	12	minor			x		x	x						
E5	1	18	19	East Street	27	12	none												
E5	1	19	20	East Street	209	12	minor			x			x		x				1,000
E5	1	21	22	East Street	130	12	major												

TABLE 2-4. SUMMARY OF SEWER PIPELINE DEFECTS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Pipe							Services				
								Debris	Leak in Pipe	Offset/ Open Joint	Cracked/ Broken Pipe/Jt	Evidence of Leakage	Roots	Est. Leak (gpd)	Broken/ Cracked	Break -in Conn.	Roots	Min Depos/ Leak	Est. Leak (gpd)
E5	1	22	23	East Street	172	12	major												
E5	1	23	24	East Street	249	12	major												
E5	1	1	2	East Street	163	12	minor												
E5	5	10a	10a1	East Street	142	8	none												
E5	5	10a1	10	East Street	45	8	none												
E5	5	10b	10a	East Street	194	8	minor			x	x								
E5	5	10c	10b	East Street	130	8	major			x	x		x						
E5	5	10d	10c	East Street	71	8	none												
E5	1	16	17	East Street	79	12	minor												
E5	1	2	3	East Street	51	12	minor												
E5	1	20	21	East Street	270	12	major												
E5	1	5	6	East Street	213	12	major												
E5	5	43	45	Granite Street	207	8	moderate				x					x			
E5	1	3	27	Hermaine Aveune	151	8	minor						x						
E5	1	27	28	Hermaine Aveune	154	8	minor									x			20
E5	5	28A	28A1	Hermaine Aveune	118	8	minor						x			x			
E5	5	28A	28	Hermaine Aveune	148	8	minor				x		x			x			
E5	5	74.8	74.7	Judith Circle	104	8	none												
E5	5	74.8	74.9	Judith Circle	137	8	none												
E5	5	74.8	74.5	Judith Circle Easement	356	8	minor		x					360					
E5	1	10	33	Lamoine Street	178	8	minor						x						
E5	1	33	34	Lamoine Street	154	8	major		x				x	100		x	x		250
E5	5	36B	36D	Malone Street	185	8	moderate				x		x						
E5	5	36A	37A	Mason Street	236	8	minor				x		x			x	x		
E5	5	23A	13A	Overlook Avenue	156	8	minor						x			x			
E5	5	29	29F	Pine Grove Avenue	268	8	major				x				x	x			
E5	1	8	30	Preston Street	252	8	minor												
E5	1	30	31	Preston Street	141	8	minor				x		x				x		
E5	1	31	32	Preston Street	117	8	minor			x		x				x			150
E5	5	40	50	Ridgeway Street	119	8	minor		x					1,440		x			
E5	5	42	40	Ridgeway Street	123	8	minor				x					x			
E5	5	43	44	Ridgeway Street	52	8	major				x								
E5	5	43	42	Ridgeway Street	123	8	moderate				x					x	x		
E5	5	74.3	74.1	Rosen Road	229	8	none												
E5	1	20	38	Sidney Street	266	8	minor				x		x				x		
E5	1	35	36	Southgate	236	8	moderate		x		x	x			x		x		400
E5	1	36	37	Southgate	184	8	minor				x								
E5	1	17	35	Southgate	352	8	moderate			x	x		x			x	x		500
E5	1	2	25	Top Hill Avenue	258	8	major												
E5	1	25	26	Top Hill Avenue	145	8	minor						x			x	x		250

TABLE 2-4. SUMMARY OF SEWER PIPELINE DEFECTS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Pipe							Services				
								Debris	Leak in Pipe	Offset/ Open Joint	Cracked/ Broken Pipe/Jt	Evidence of Leakage	Roots	Est. Leak (gpd)	Broken/ Cracked	Break -in Conn.	Roots	Min Depos/ Leak	Est. Leak (gpd)
E5	5	26A	26	Top Hill Avenue	154	8	minor									x	x		
E5	5	29E	26A	Top Hill Avenue	297	8	moderate				x		x		x	x	x		
E5	1	4	29	Upland Road	325	8	minor				x								
E5	5	29A	29C	Upland Road	58	8	minor		x		x			180					
E5	5	29A	29	Upland Road	223	8	moderate				x	x				x		x	180
E5	5	29D	29C	Upland Road	246	8	moderate				x					x			
E5	5	29E	29D	Upland Road	158	8	major		x		x			180					
E5	5	29E	stub	Upland Road	101	10	moderate		x					2,880				x	1,080
E5	5	29A	29B	Walters Avenue	271	8	moderate				x					x			
E5	5	21	20A	Winfield Street	242	10	major				x		x		x	x			
E5	1	22	39	Winfield Street	235	10	major												
E5	5	20A	39	Winfield Street	243	10	major			x	x		x			x			
E5	5	23A	21	Winfield Street	244	10	major				x				x	x			
E5	5	40	41	Winstead Avenue	128	8	minor						x			x			
E5	5	49	48	Winstead Avenue	243	8	moderate				x					x			
E5	5	50	49	Winstead Avenue	243	8	moderate				x				x		x		
E5	5	36A	41	Winstead Avenue	146	8	moderate				x		x						
E5	5	36B	36A	Winstead Avenue	251	8	moderate				x		x			x			
E5	5	36B	36C	Winstead Avenue	214	8	moderate			x	x					x			
							Total =							19,470					21,310

Note:

Lines that are shaded have been/will be replaced/rehabilitated under separate contracts.

Report 1 - 1998 TV Inspection Report

Report 1* - 1998 TV Inspection Report sewers previously television inspected by M&E between 1992-1994

Report 1** - 1998 TV Inspection Report sewers television inspected by Araco under separate contract to the town

Report 2 - Jan. 1999

Report 5 - Manor Study


E1-1
E3-1
E4-1
E4-2
D1-2
D2-1
D2-3
D2-2
E5
E3-2
Rustin Pond
LEGEND
46 Manhole With Manhole Number
54 Manhole With Street Address
MWRA Interceptors
Town of Dedham Sewer
Sewer Sub-Area Boundary
Glenway/Hamilton Avenue Study Area
Right of Way
Corporate Boundary
Street Edge
Rail Lines
Sewers with Defects
Service Connections With Defects
800
0
800
SCALE IN FEET
TOWN OF DEDHAM, MASSACHUSETTS
FIGURE 2-2. SEWERS WITH DEFECTS
M&E
Metcalf & Eddy
defecta11x17.aml

Table 2-4 also includes a column that categorizes the severity of defects observed within each sewer pipeline as minor, moderate, or major. Sewer pipelines with minor defects would generally include roots and leaky joints that may be addressed by performing chemical treatment for root control and joint testing and sealing. Sewer pipelines with moderate defects would generally include roots, leaky joints, and minor cracked pipe that may be addressed by performing the aforementioned methods as well as spot repairs with chemical grout or the installation of a short structural liner. Sewer pipelines with major defects would generally include cracked or broken pipe throughout the length of the sewer pipeline that may be address by relining or dig-and-replacement of the existing pipe. Specific recommendations on the rehabilitation of the sewers in the study area are presented in Section Four of this report.

As shown by the highlighting in Table 2-4, there are a number of sewers where replacement work will be performed under the proposed Glenway/Hamilton Avenue construction contract or where rehabilitation work has already been performed by the town since the time the original TV inspection work was conducted. In addition, there are a number of sewers that could not be fully inspected due to root blockages, collapsed pipe, protruding service connections, or severe pipe sags that blocked the progression of the camera. This is noted in the defect severity column of Table 2-4 where sewers that could not be fully inspected are labeled as incomplete. These sewers require repairs such as root treatment, cutting back a protruding service connection, or replacement of a collapsed section to open the line to allow for the passage of the television camera to complete inspection of the line. Where appropriate, recommendations to this effect have been included in Section Four of this report.

The quantity of infiltration entering the sanitary sewers from both the mainline and service connections for the entire study area was estimated based on visual assessment of each infiltration source. The total estimated infiltration identified from the defects listed in Table 2-4 is approximately 40,800 gpd. Of this total, approximately 19,500 gpd of infiltration is contributed by defects in the mainline sewer and 21,300 gpd is contributed by service connections. These totals do not include infiltration observed within the mainline sewers and service connections that have since been rehabilitated by the town. It has been assumed that the infiltration from these sewers would be eliminated from the system.

Table 2-5 is a list of approximately 1,160 feet of sewer that still have not been TV inspected due to surcharged conditions and access problems. As time and funding permits, the town should take the necessary steps to conduct TV inspection of these sewers.

TABLE 2-5. LIST OF SEWERS NOT INSPECTED

Sewer Subarea	From MH	To MH	Street Name	Pipe Length (ft)	Reason Not Inspected
E3-2	24A	39	Rustcraft Road Easement	230	Cannot locate either manhole
E3-2	41	49	Allied Drive Easement	270	Cannot access MH 49, debris
E3-2	42	42A	Allied Drive Easement	200	Surcharged, cannot locate MH 42A
E3-2	42	44	Allied Drive	130	Surcharged
E3-2	44	stub	Allied Drive	130	Surcharged
E3-2	71	stub	Willard Street Easement	200	Access problems
Total				1,160	

SECTION THREE
HYDRAULIC CAPACITY ANALYSIS OF SEWER SYSTEM

The following section presents the results of the hydraulic capacity analysis performed for the entire sewer system within the Glenway/Hamilton Avenue study area. The analysis evaluated the hydraulic capacity of all the sewers in subareas E3-2, E4-1, E4-2 and E5. As noted previously, these sewers are tributary to the East Brook Replacement Interceptor (EBRI) located along Fairbanks Road. Since the town completed the construction of the EBRI in 1998, there have been no reported occurrences of sanitary sewer overflows to East Brook or system back-ups to homes located within the Fairbanks Road area. However, previous to the EBRI project, this area of town was subject to frequent overflows of raw sewage to East Brook as a result of surcharged conditions in the original East Brook Interceptor.

Although the EBRI project was successful in eliminating the aforementioned problems, there are two low-lying areas upstream of the EBRI that continue to experience problems with sanitary sewer overflows and system back-ups. The two areas include the sewers located along Glenway and Hamilton Avenue, and under extreme wet weather, peak flow conditions, the sewers located along East Street near Norwich Street. The purpose of this evaluation, therefore, was to identify the hydraulic limitations that may be adversely affecting the system during wet weather, peak flow conditions.

FIELD SURVEY OF EXISTING CONDITIONS

Under the original scope of work for this project, it was anticipated that the hydraulic capacity analysis would be performed utilizing rim and invert elevations, pipe diameters, and pipe lengths tabulated by others as part of the town's on-going effort to develop and implement a geographic information system (GIS). However, due to prolonged delays in the completion of the work by others, the town directed M&E to obtain the required data by conducting a field survey of the Glenway/Hamilton Avenue study area. This work was subsequently performed by Aaberg Associates, Inc. as part of the survey effort required for the design of replacement sewers on a portion of Rustcraft Road, Glenway, and Hamilton Avenue. The field survey included mapping

the existing sewer system utilizing global positioning system (GPS) survey methods. Rim and invert elevations for the sewer manholes were obtained by real-time kinematic GPS equipment. With this equipment, the survey location of existing sewer manhole structures may be obtained within 0.1 feet horizontal and vertical accuracy. As part of this effort, the field crews opened each sewer manhole structure to visually inspect from above ground for pipe connections and size.

The end product of the effort above is a detailed map of the existing sanitary sewer system within the Glenway/Hamilton Avenue study area, including the exact location of sewer manholes based on the GPS information, rim and invert elevations, pipe sizes, and flow directions. This information served as the basis for conducting a hydraulic capacity analysis of the existing sanitary sewer system as described below.

HYDRAULIC CAPACITY ANALYSIS

Using Manning's Equation, a hydraulic capacity analysis was performed for the sewers in each subarea of the Glenway/Hamilton Avenue study area. For analysis purposes, the flow capacity of each sewer was calculated assuming full flow conditions and a Manning's roughness coefficient, or "n" value, of 0.013 for gravity flow in pipe channels. Additionally, the slope of each sewer was calculated by dividing the difference between the upstream and downstream invert elevations by the length of sewer pipe. For comparison purposes, the minimum slopes typically recommended for design of small diameter gravity sewers are presented below:

Pipe Diameter	Minimum Slope @ Velocity = 2 ft/sec
8"	0.0040
10"	0.0030
12"	0.0022
15"	0.0015
18"	0.0012
21"	0.0010

The results of the hydraulic capacity analysis for each sewer subarea are summarized in the following paragraphs.

Subarea E3-2

Table 3-1 summarizes the results of the capacity analysis for the sewers in subarea E3-2 going in the direction from upstream to downstream. As indicated by the shading of rows, there are numerous sections of sewer that have been constructed at less than minimum slope. These sewers are more likely to have problems with sediment deposition and back-ups due to poor flow velocities. Figure 3-1 has been highlighted to show the sewers constructed at less than minimum slope. In subarea E3-2, this includes almost the entire length of the existing sewer on Rustcraft Road as well as portions of the existing sewer on Elm Street, Robin Wood Road, Willard Street, and the Allied Drive easement.

Table 3-1 also includes a column that identifies whether there is the potential for a bottleneck to exist under peak flow conditions that would restrict the flow conveyed via the downstream sewer. This determination was based solely on comparison of the full flow capacities of the downstream versus the upstream sewer(s). In the absence of supporting data, such as flow monitoring results or field observation of system back-ups, it is difficult to confirm whether sewer surcharging occurs at these locations during peak flow conditions. However, the intent of this analysis was to identify where capacity limitations may exist due to the existing hydraulic conditions which may further explain the factors contributing to known problem areas within the system.

Review of Known Problem Areas. Through discussions with town personnel, the existing sewer on Rustcraft Road between Elm Street and the EBRI at McKinley Avenue has a long history of maintenance related problems. Based on the field survey data, it would appear that the existing sewer was constructed at an average slope of 0.0018. This is below the minimum slope of 0.0022 typically recommended for the design of 12-inch gravity sewer, and may be a contributing factor to the buildup of sediment/debris in the pipe.

TABLE 3-1. CAPACITY ANALYSIS FOR SUBAREA E3-2

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E3-2	Rustcraft Road	20-22	93.6	94.09	283	12	0.0017	1.48	0.96	yes*
E3-2	Rustcraft Road	22-23	93.27	93.6	192	12	0.0017	1.48	0.95	no
E3-2	Rustcraft Road	23-24	92.69	93.27	170	12	0.0034	2.08	1.34	no
E3-2	Rustcraft Road	24-24a	92.28	92.69	107	12	0.0038	2.20	1.42	no
E3-2	Rustcraft Road	24a-26	92.19	92.28	171	12	0.0005	0.82	0.53	yes*
E3-2	Rustcraft Road	26-26a	91.94	92.19	160	12	0.0016	1.41	0.91	no
E3-2	Rustcraft Road	26a-27	91.33	91.94	160	12	0.0038	2.20	1.42	no
E3-2	Rustcraft Road	27-28	91.43	91.33	172	12	-0.0006	(1)	(1)	yes
E3-2	Rustcraft Road	28-29	91.4	91.43	233	12	0.0001	0.40	0.26	no
E3-2	Rustcraft Road	29-30	90.59	91.4	234	12	0.0035	2.10	1.35	no
E3-2	Rustcraft Road	30-31	90.39	90.59	140	12	0.0014	1.35	0.87	yes
E3-2	Rustcraft Road	31-32	89.91	90.39	267	12	0.0018	1.51	0.98	no
E3-2	Rustcraft Road	32-33	89.55	89.91	178	12	0.0020	1.60	1.04	no
E3-2	Rustcraft Road	33-34	89.24	89.55	175	12	0.0018	1.50	0.97	yes
E3-2	Rustcraft Road	34-35	88.97	89.24	162	12	0.0017	1.45	0.94	no
E3-2	Rustcraft Road	35-36	88.52	88.97	249	12	0.0018	1.51	0.98	no
E3-2	Rustcraft Road	36-38	88.27	88.52	189	12	0.0013	1.30	0.84	yes
E3-2	Rustcraft Road Easement	21-20	94.09	94.2	103	12	0.0011	1.16	0.75	no
E3-2	Rustcraft Road Easement	19A-20	94.09	94.33	117	12	0.0021	1.61	1.04	yes
E3-2	Rustcraft Road Easement	19-19A	94.33	95.22	220	12	0.0040	2.27	1.46	no
E3-2	Rustcraft Road Easement	18-19	95.22	95.81	215	12	0.0027	1.87	1.21	no
E3-2	Rustcraft Road Easement	17-18	95.81	96.39	164	12	0.0035	2.12	1.37	yes
E3-2	Rustcraft Road Easement	16-17	96.39	96.73	52	12	0.0065	2.88	1.86	no
E3-2	Rustcraft Road Easement	15-16	96.73	98.49	246	12	0.0072	3.01	1.95	yes
E3-2	Rustcraft Road Easement	5-15	98.49	100.33	198	12	0.0093	3.43	2.22	no
E3-2	Elm Street	1-2	105.3	107.93	191	8	0.0138	1.42	0.92	no
E3-2	Elm Street	2-3	102.65	105.3	167	8	0.0159	1.52	0.98	no
E3-2	Elm Street	3-4	102.23	102.65	167	8	0.0025	0.61	0.39	yes
E3-2	Elm Street	4-5	100.33	102.23	167	8	0.0114	1.29	0.83	no
E3-2	Elm Street	9-8	114.56	114.84	96	8	0.0029	0.65	0.42	no
E3-2	Elm Street	8-7	101.27	114.56	248	8	0.0536	2.80	1.81	no
E3-2	Elm Street	7-6	100.62	101.27	200	8	0.0032	0.69	0.45	yes

TABLE 3-1. CAPACITY ANALYSIS FOR SUBAREA E3-2

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E3-2	Elm Street	6-5	100.33	100.62	51	8	0.0057	0.91	0.59	yes*
E3-2	Robin Wood Road	14-13	118.98	121.07	50	8	0.0418	2.47	1.60	no
E3-2	Robin Wood Road	13-12	107.21	118.98	266	8	0.0442	2.54	1.64	no
E3-2	Robin Wood Road	12-11	105.98	107.21	178	8	0.0069	1.00	0.65	yes
E3-2	Robin Wood Road	11-10	105	105.98	288	8	0.0034	0.70	0.46	no
E3-2	Robin Wood Road	10-6	100.62	105	249	8	0.0176	1.60	1.04	no
E3-2	Willard Street	55-56	110.46	111.42	112	8	0.0086	1.12	0.72	no
E3-2	Willard Street	56-57	98.99	110.46	242	8	0.0474	2.63	1.70	no
E3-2	Willard Street	57-58	98.97	98.99	55	10	0.0004	0.42	0.27	yes
E3-2	Willard Street	58-59	98.55	98.97	45	10	0.0093	2.12	1.37	no
E3-2	Willard Street	66-65	111.56	111.95	120	8	0.0033	0.69	0.45	no
E3-2	Willard Street	65-64	111.16	111.56	72	8	0.0056	0.90	0.58	no
E3-2	Willard Street	64-63	110.99	111.16	63	8	0.0027	0.63	0.41	yes
E3-2	Willard Street	63-62	106.42	110.99	148	8	0.0309	2.12	1.37	no
E3-2	Willard Street	62-61	104.22	106.42	70	8	0.0314	2.14	1.38	no
E3-2	Willard Street	61-60	101.94	104.22	75	8	0.0304	2.11	1.36	yes
E3-2	Willard Street	60-59	98.55	101.94	47	8	0.0721	3.24	2.10	no
E3-2	Allied Drive Easement	59-67	97.88	98.55	126	8	0.0053	0.88	0.57	yes*
E3-2	Allied Drive Easement	67-68	97.38	97.63	58	12	0.0043	2.34	1.51	no
E3-2	Allied Drive Easement	68-69	96.49	97.08	211	12	0.0028	1.88	1.22	yes
E3-2	Allied Drive Easement	69-70	96.21	96.49	79	12	0.0035	2.12	1.37	no
E3-2	Allied Drive Easement	70-71	95.51	96.21	168	12	0.0042	2.30	1.49	no
E3-2	Allied Drive Easement	71-51	94.73	95.31	221	12	0.0026	1.82	1.18	yes
E3-2	Allied Drive Easement	51-50b	94.56	95.08	59	12	0.0088	3.34	2.16	no
E3-2	Allied Drive Easement	50b-50a	94.44	94.56	97	12	0.0012	1.25	0.81	yes
E3-2	Allied Drive Easement	50a-50	93.9	94.44	140	12	0.0039	2.21	1.43	no
E3-2	Allied Drive Easement	50-49	93.85	93.9	87	12	0.0006	0.85	0.55	yes
E3-2	Allied Drive Easement	49-41	93.52	93.75	217	12	0.0011	1.16	0.75	no
E3-2	Allied Drive Easement	41-40	93.08	93.5	218	12	0.0019	1.56	1.01	yes*
E3-2	Allied Drive Easement	40-39a	93	93.08	95	12	0.0008	1.03	0.67	no
E3-2	Allied Drive Easement	39a-39	92.91	93	186	12	0.0005	0.78	0.51	yes
E3-2	Allied Drive Easement	39-24a	92.28	92.91	115	12	0.0055	2.64	1.70	no

TABLE 3-1. CAPACITY ANALYSIS FOR SUBAREA E3-2

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E3-2	Allied Drive Easement	49.1-49	94.01	93.77	82	12	-0.0029	(1)	(1)	yes
E3-2	Allied Drive	44-42	93.67	94.1	110	12	0.0039	2.23	1.44	no
E3-2	Allied Drive	43-42a	mh buried	96.7	?	8	(2)	(2)	(2)	?
E3-2	Allied Drive	42a-42	93.89	mh buried	?	12	(2)	(2)	(2)	?
E3-2	Allied Drive	42-41	93.64	93.71	133	12	0.0005	0.82	0.53	yes*

Notes:

Lines that are shaded indicate sewers with less than minimum slope.

(1) The flow capacity cannot be calculated using Manning's Equation due to the adverse slope of the existing sewer.

(2) The slope and flow capacity cannot be calculated due to missing information associated with the buried manhole.

* The potential bottleneck is due to the addition of flow from two or more upstream sewers.


E1-1
E3-1
E4-1
E4-2
D1-2
D2-1
D2-3
D2-2
E5
E3-2
Rustin Pond
LEGEND
MWRA Interceptors
Town of Dedham Sewer
45
Manhole With Manhole Number
64
Manhole With Street Address
Sewer Sub-Area Boundary
Sewer Sub-Area Boundary for Capacity Analysis
Street Edge
Rail Lines
Right of Way
Corporate Boundary
Sewers with Less Than Minimum Slope
800
0
800
SCALE IN FEET
TOWN OF DEDHAM, MASSACHUSETTS
FIGURE 3-1. SEWER SUBAREA CAPACITY ANALYSIS
M&E
Metcalf & Eddy
capacity_gh_11x17.eml

The TV inspection of this sewer also identified multiple sags throughout its entire length. According to record plan information, a portion of the existing sewer was constructed on a pile foundation which suggests that poor soil conditions exist in the area. This is further supported by the fact that a significant portion of the EBRI was constructed on pile foundations due to the poor soil conditions observed along the project corridor between Rustcraft Road and Eastern Avenue.

Finally, based on comparison of the rim and invert elevations, there are sections of the existing sewer that have less than two feet of cover. In comparison, new sewers located in paved roadways are generally designed with seven feet of cover, with a minimum of six feet typically required. The existing sewer on Rustcraft Road may be an example of where the installation of a pump station and force main may have been more appropriate due to the relatively flat topography and poor soil conditions within the area. Although it should be noted that the town of Dedham's sewer system operates entirely by gravity, as a result of performing work throughout the system, there are several areas where a pump station and force main could have been constructed to minimize the potential for flow related problems to occur. Section Four of this report evaluates the alternatives available to the town in addressing problem areas such as the existing sewer along Rustcraft Road.

Subarea E4-1

Table 3-2 summarizes the results of the capacity analysis for the sewers in subarea E4-1, including whether there is the potential for a bottleneck to exist based on comparison of the full flow capacities of the downstream versus the upstream sewer(s). The table is organized going in the direction from upstream to downstream. As indicated by the shading of rows, there are numerous sections of sewer that have been constructed at less than minimum slope. These sewers are more likely to have problems with sediment deposition and back-ups due to poor flow velocities. Figure 3-1 has been highlighted to show the sewers constructed at less than minimum slope. In subarea E4-1, this includes the entire length of the existing sewer on Hamilton Avenue, Glenway, Lilly Lane, and Shiretown Road as well as portions of the existing sewer on East

TABLE 3-2. CAPACITY ANALYSIS FOR SUBAREA E4-1

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E4-1	Rustcraft Road Easement	180-77b	87.50	87.80	316	18	0.0009	3.24	2.09	no
E4-1	Rustcraft Road Easement	77b-77a	87.80	88.70	256	16	0.0035	4.55	2.94	yes*
E4-1	Rustcraft Road	77a-77	88.70	89.80	199	16	0.0055	5.70	3.69	no
E4-1	Rustcraft Road	77-73	89.80	90.10	198	18	0.0015	4.09	2.64	yes*
E4-1	Rustcraft Road	73-46	90.10	90.80	219	18	0.0032	5.94	3.84	no
E4-1	East Street	3-4	114.91	118.79	235	8	0.0165	1.55	1.00	no
E4-1	East Street	4-4a	114.77	114.91	18	8	0.0078	1.07	0.69	yes
E4-1	East Street	4a-5	108.80	114.77	90	8	0.0663	3.11	2.01	no
E4-1	East Street	5-10	107.45	108.90	209	8	0.0069	1.01	0.65	yes*
E4-1	East Street	10-11	106.07	107.45	209	8	0.0066	0.98	0.63	no
E4-1	East Street	11-23	102.45	105.97	177	8	0.0199	1.70	1.10	yes*
E4-1	East Street	23-44	97.14	102.45	175	8	0.0303	2.10	1.36	no
E4-1	East Street	44-45	93.60	97.10	175	8	0.0200	1.71	1.10	yes*
E4-1	East Street	45-46	90.80	93.60	158	8	0.0177	1.61	1.04	no
E4-1	East Street	99-1	93.31	93.62	198	12	0.0016	1.41	0.91	no
E4-1	East Street	99-98	92.80	93.31	220	18	0.0023	5.06	3.27	no
E4-1	East Street	98-82	91.70	92.70	347	12	0.0029	1.91	1.24	yes
E4-1	East Street	82-79	91.50	91.70	76	12	0.0026	1.83	1.18	yes*
E4-1	East Street	79-46	90.80	91.50	280	12	0.0025	1.78	1.15	yes*
E4-1	Sprague Street	884-882	93.58	95.62	98	12	0.0208	5.14	3.32	no
E4-1	Sprague Street	99-882	93.31	93.58	114	8	0.0024	0.59	0.38	yes
E4-1	Ford Street	75-74	94.70	99.69	48	8	0.1040	3.89	2.52	no
E4-1	Ford Street	74-73	90.80	94.70	226	8	0.0173	1.59	1.03	yes
E4-1	Hamilton Avenue	87-86	93.00	94.00	197	8	0.0051	0.86	0.56	no
E4-1	Hamilton Avenue	86-85	93.10	93.00	72	8	-0.0014	(1)	(1)	yes
E4-1	Hamilton Avenue	85-84	92.50	93.10	233	8	0.0026	0.61	0.40	no
E4-1	Hamilton Avenue	84-79	91.50	92.50	267	8	0.0037	0.74	0.48	yes*
E4-1	Glenway	83-84	92.50	93.10	311	8	0.0019	0.53	0.34	no
E4-1	Sanderson Avenue	1-2	123.06	134.22	302	8	0.0370	2.32	1.50	no
E4-1	Sanderson Avenue	2-3	118.79	123.06	310	8	0.0138	1.42	0.92	yes
E4-1	Boulevard Road	6-7	132.95	142.19	270	8	0.0342	2.23	1.44	no
E4-1	Boulevard Road	7-8	124.93	132.95	269	8	0.0298	2.09	1.35	yes

TABLE 3-2. CAPACITY ANALYSIS FOR SUBAREA E4-1

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E4-1	Boulevard Road	8-9	117.50	124.93	269	8	0.0276	2.01	1.30	no
E4-1	Boulevard Road	9-5	109.30	117.50	260	8	0.0315	2.15	1.39	no
E4-1	Monroe Street	14-15	132.13	136.53	308	8	0.0143	1.44	0.93	no
E4-1	Monroe Street	15-16	131.24	132.13	224	8	0.0040	0.76	0.49	yes
E4-1	Monroe Street	16-19	130.36	131.24	198	8	0.0044	0.81	0.52	yes*
E4-1	Monroe Street	19-20	127.37	130.36	226	8	0.0132	1.39	0.90	no
E4-1	Monroe Street	20-21	121.20	127.37	225	8	0.0274	2.00	1.29	no
E4-1	Monroe Street	21-22	113.67	121.20	271	8	0.0278	2.01	1.30	no
E4-1	Monroe Street	22-11	106.10	113.67	272	8	0.0278	2.02	1.30	no
E4-1	Monroe Street	14-13	132.13	136.53	85	8	0.0518	2.75	1.78	no
E4-1	Monroe Street	13-12	127.61	132.13	177	8	0.0255	1.93	1.25	no
E4-1	Monroe Street	12-12.1	127.16	127.61	47	8	0.0096	1.18	0.76	yes
E4-1	Monroe Street Easement	12.1-24	126.12	127.16	293	8	0.0035	0.72	0.47	no
E4-1	Madison Street	39-40	124.88	130.66	288	8	0.0201	1.71	1.11	no
E4-1	Madison Street	40-41	118.63	124.88	287	8	0.0218	1.78	1.15	no
E4-1	Madison Street	41-43	111.66	118.63	319	8	0.0218	1.79	1.15	yes*
E4-1	Madison Street	43-44	97.20	111.66	319	8	0.0453	2.57	1.66	no
E4-1	Madison Street	33-34	128.52	129.25	248	8	0.0029	0.66	0.42	no
E4-1	Madison Street	34-35	127.80	128.47	231	8	0.0029	0.65	0.42	no
E4-1	Madison Street	35-36	127.02	127.73	210	8	0.0034	0.70	0.45	no
E4-1	Madison Street	26-24	126.06	126.30	164	8	0.0015	0.46	0.30	no
E4-1	Madison Street	25-24	126.14	127.58	280	8	0.0051	0.87	0.56	no
E4-1	Jefferson Street	57-58	125.16	125.34	72	8	0.0025	0.60	0.39	no
E4-1	Jefferson Street	58-60	124.02	125.04	308	8	0.0033	0.70	0.45	yes*
E4-1	Jefferson Street	60-61	123.00	124.02	299	8	0.0034	0.71	0.46	no
E4-1	Jefferson Street	61-62	122.13	123.00	299	8	0.0029	0.65	0.42	yes
E4-1	Jefferson Street	62-68	119.35	122.13	221	8	0.0126	1.35	0.88	yes*
E4-1	Jefferson Street	68-69	117.60	119.35	213	8	0.0082	1.09	0.71	no
E4-1	Jefferson Street	69-70	115.47	117.60	212	8	0.0100	1.21	0.78	no
E4-1	Jefferson Street	70-71	110.99	115.47	212	8	0.0211	1.76	1.13	yes*
E4-1	Jefferson Street	71-72	101.05	110.99	213	8	0.0467	2.61	1.69	no
E4-1	Jefferson Street	72-46	92.36	101.05	215	8	0.0404	2.43	1.57	yes*

TABLE 3-2. CAPACITY ANALYSIS FOR SUBAREA E4-1

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E4-1	Adams Street	80-81	98.20	107.17	213	8	0.0421	2.48	1.60	no
E4-1	Adams Street	81-82	91.70	98.20	265	8	0.0245	1.89	1.22	yes
E4-1	Adams Street	89-90	119.20	129.55	219	8	0.0473	2.63	1.70	no
E4-1	Adams Street	90-91	113.23	119.20	268	8	0.0223	1.80	1.17	yes
E4-1	Adams Street	47-48	135.15	136.09	139	8	0.0068	0.99	0.64	no
E4-1	Adams Street	48-49	132.05	135.15	120	8	0.0258	1.94	1.25	no
E4-1	Adams Street	49-53	127.30	128.21	243	8	0.0037	0.74	0.48	yes*
E4-1	Adams Street	53-53.1	126.75	127.30	92	8	0.0060	0.93	0.60	yes*
E4-1	Adams Street	53.1-56	126.25	126.65	194	8	0.0021	0.55	0.35	no
E4-1	Grant Avenue	94-95	136.35	152.34	248	8	0.0645	3.07	1.98	no
E4-1	Grant Avenue	95-96	109.54	136.35	248	8	0.1081	3.97	2.57	no
E4-1	Grant Avenue	96-97	97.80	109.54	259	8	0.0453	2.57	1.66	yes*
E4-1	Grant Avenue	97-98	92.70	97.80	261	8	0.0195	1.69	1.09	no
E4-1	Grant Avenue	67-66	139.31	140.40	285	8	0.0038	0.75	0.48	no
E4-1	Greenwood Avenue	26.1-26	97.07	116.13	303	8	0.0629	3.03	1.96	no
E4-1	Greenwood Avenue	26-99	93.31	97.07	174	8	0.0216	1.78	1.15	yes
E4-1	Elmwood Avenue	92-91	113.23	115.80	258	8	0.0100	1.21	0.78	no
E4-1	Elmwood Avenue	91-93	111.73	113.23	174	8	0.0086	1.12	0.72	yes*
E4-1	Elmwood Avenue	93-96	109.54	111.73	174	8	0.0126	1.36	0.88	no
E4-1	Elmwood Avenue	42-41	118.58	121.90	259	8	0.0128	1.37	0.88	no
E4-1	Elmwood Avenue	41-70	115.47	118.84	338	8	0.0100	1.21	0.78	no
E4-1	Mt Vernon Street	68-65	138.78	139.31	92	8	0.0058	0.92	0.59	no
E4-1	Mt Vernon Street	65-64	130.18	138.66	258	8	0.0329	2.19	1.42	no
E4-1	Mt Vernon Street	64-63	127.44	130.18	139	8	0.0197	1.70	1.10	yes
E4-1	Mt Vernon Street	63-62	125.30	127.44	199	8	0.0108	1.25	0.81	no
E4-1	Mt Vernon Street	37-36	129.32	133.46	200	8	0.0207	1.74	1.12	no
E4-1	Mt Vernon Street	36-38	124.48	127.02	174	8	0.0146	1.46	0.94	yes*
E4-1	Mt Vernon Street	38-62	122.13	124.48	164	8	0.0143	1.45	0.93	no
E4-1	Mt Vernon Street	17-18	136.55	143.21	273	8	0.0244	1.89	1.22	no
E4-1	Mt Vernon Street	18-16	131.24	133.83	273	8	0.0095	1.18	0.76	yes
E4-1	Netta Road	52-51	129.48	133.09	145	8	0.0249	1.91	1.23	no
E4-1	Netta Road	51-50	128.85	129.48	153	8	0.0041	0.78	0.50	yes

TABLE 3-2. CAPACITY ANALYSIS FOR SUBAREA E4-1

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E4-1	Netta Road	50-49	128.21	128.85	145	8	0.0044	0.80	0.52	no
E4-1	Lilly Lane	55-54	128.18	129.44	285	6	0.0044	0.37	0.24	no
E4-1	Lilly Lane	54-53	127.30	128.18	285	6	0.0031	0.31	0.20	yes
E4-1	Shiretown Road	56.1-56	126.25	126.50	150	8	0.0017	0.49	0.32	no
E4-1	Shiretown Road	56-57	125.31	126.25	253	8	0.0037	0.74	0.48	yes*
E4-1	Jefferson Street Easement	24-59	127.15	126.08	176	8	-0.0061	(1)	(1)	yes
E4-1	Jefferson Street Easement	59-58	125.01	127.15	128	8	0.0167	1.56	1.01	no
E4-1	Circuit Road	32-30	130.38	131.92	281	8	0.0055	0.89	0.58	no
E4-1	Circuit Road	30-27	129.03	130.38	281	8	0.0048	0.84	0.54	yes*
E4-1	Circuit Road	27-25	127.60	129.00	293	8	0.0048	0.84	0.54	yes*
E4-1	Woodland Road	29-28	138.93	141.05	203	8	0.0104	1.23	0.80	no
E4-1	Woodland Road	28-27	128.95	138.82	118	8	0.0836	3.49	2.26	no
E4-1	Fales Road	31-30	135.38	144.12	201	8	0.0435	2.52	1.63	no

Notes:

Lines that are shaded indicate sewers with less than minimum slope.

(1) The flow capacity cannot be calculated using Manning's Equation due to the adverse slope of the existing sewer.

* The potential bottleneck is due to the addition of flow from two or more upstream sewers.

Street, Sprague Street, Monroe Street, Madison Street, Jefferson Street, Adams Street, and Grant Avenue.

Review of Known Problem Areas. As indicated in Table 3-2, there is the potential for a bottleneck in the cross country section of sewer immediately upstream of the EBRI between Rustcraft Road and Fairbanks Road. Based on the field survey data, it would appear that the existing sewer was constructed at a slope of 0.0009. This is below the minimum slope of 0.0012 typically recommended for the design of 18-inch gravity sewer. Heading toward East Street, the pipe diameter of the existing sewer then changes back and forth between 16- and 18-inches with varying slopes that result in theoretical flow capacities of between 2.6 and 3.8 mgd using Manning's equation. However, the actual flow capacity is controlled by the downstream most section of sewer which is limited to approximately 2 mgd.

Through field observation, M&E has confirmed that the sewer on Rustcraft Road begins to surcharge at the manhole immediately upstream of the EBRI during wet weather, peak flow conditions. Further, the sewer which is most impacted by surcharging is the 12-inch sewer on East Street (south of Rustcraft Road). This is primarily due to the fact that the topography along East Street, going from Rustcraft Road to Route 95, is relatively flat in comparison to the other areas tributary to this portion of the system. For example, at the intersection of East Street and Rustcraft Road, flow from three inlet sewers is combined. The sewers from East Street (north of Rustcraft Road) and Jefferson Street were constructed at slopes of approximately 2% and 4%, respectively. Meanwhile, the sewer on East Street (south of Rustcraft Road) was constructed at a minimum slope of 0.25%. Under a surcharged condition, therefore, the length of sewer impacted per foot of surcharge is approximately 400 feet in the direction of East Street (south of Rustcraft Road). Conversely, the length of sewer impacted in the direction of East Street (north of Rustcraft Road) and Jefferson Street is 25 and 50 feet, respectively.

Eventually, as the level of surcharge increases in this portion of the system, overflows and service back-ups begin to occur in areas with low-lying topography along on East Street (south of Rustcraft Road). This is evidenced by the recurring problems with overflows at Hamilton Avenue and Glenway where the existing sewer was constructed with minimal slope and cover

due to the low-lying topography, allowing flow by gravity to the existing sewer on East Street. At the furthest upstream point on Glenway, the existing sewer has less than 12-inches of cover. Under extreme high flow conditions, service back-ups are also known to occur along East Street in the vicinity of Norwich Street which is another area with low-lying topography.

To address the aforementioned problems, the town has since initiated the design of replacement sewers along Rustcraft Road to East Street, and on Hamilton Avenue and Glenway. This project is discussed further in the evaluation of alternatives presented in Section Four of this report.

Subarea E4-2

Table 3-3 summarizes the results of the capacity analysis for the sewers in subarea E4-2, including whether there is the potential for a bottleneck to exist based on comparison of the full flow capacities of the downstream versus the upstream sewer(s). The table is organized going in the direction from upstream to downstream. As indicated by the shading of rows, there are a number of sections of sewer that have been constructed at less than minimum slope. These sewers are more likely to have problems with sediment deposition and back-ups due to poor flow velocities. Figure 3-1 has been highlighted to show the sewers constructed at less than minimum slope. In subarea E4-2, this includes portions of the existing sewer on Cedar Street, Nobel Road, Taylor Avenue, Kimball Road, and Beech Street.

Review of Known Problem Areas. Through discussions with town personnel, there are no reported problems areas within sewer subarea E4-2.

Subarea E5

Table 3-4 summarizes the results of the capacity analysis for the sewers in subarea E5, including whether there is the potential for a bottleneck to exist based on comparison of the full flow capacities of the downstream versus the upstream sewer(s). The table is organized going in the direction from upstream to downstream. As indicated by the shading of rows, there are numerous sections of sewer that have been constructed at less than minimum slope. These

TABLE 3-3. CAPACITY ANALYSIS FOR SUBAREA E4-2

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E4-2	Sprague Street	38-37	158.20	no mh	148	8	(1)	(1)	(1)	no
E4-2	Sprague Street	37-39	152.93	158.20	282	8	0.0187	1.65	1.07	no
E4-2	Sprague Street	39-40	146.19	152.93	145	8	0.0465	2.60	1.68	no
E4-2	Sprague Street	40-41	137.99	146.19	262	8	0.0313	2.14	1.38	yes
E4-2	Sprague Street	41-66	131.83	137.99	249	8	0.0247	1.90	1.23	no
E4-2	Sprague Street	66-50	117.95	131.83	249	8	0.0557	2.85	1.84	no
E4-2	Sprague Street	50-32	108.13	117.95	196	8	0.0501	2.70	1.75	yes
E4-2	Sprague Street	32-455	97.54	108.13	187	8	0.0566	2.87	1.86	no
E4-2	Sprague Street	455-884	95.62	97.54	100	12	0.0192	4.94	3.19	yes*
E4-2	Cedar Street	28-29	137.48	138.14	245	8	0.0027	0.63	0.41	no
E4-2	Cedar Street	29-34	136.65	137.48	242	8	0.0034	0.71	0.46	yes*
E4-2	Cedar Street	34-414	134.29	136.65	214	8	0.0110	1.27	0.82	no
E4-2	Cedar Street	414-425	116.01	134.29	199	8	0.0919	3.66	2.37	no
E4-2	Cedar Street	425-441	107.14	116.01	170	8	0.0522	2.76	1.78	yes*
E4-2	Cedar Street	441-455	97.54	107.14	169	8	0.0568	2.88	1.86	no
E4-2	Nobel Road	36-37	158.20	159.16	199	8	0.0048	0.84	0.54	no
E4-2	Nobel Road	35-36	159.16	159.28	178	8	0.0007	0.31	0.20	no
E4-2	Taylor Avenue	9-10	157.78	158.91	306	8	0.0037	0.73	0.47	no
E4-2	Taylor Avenue	10-11	157.15	157.78	141	8	0.0045	0.81	0.52	no
E4-2	Taylor Avenue	24-25	154.39	158.22	230	8	0.0167	1.56	1.01	no
E4-2	Taylor Avenue	25-26	142.93	154.39	230	8	0.0498	2.70	1.74	no
E4-2	Taylor Avenue	26-27	131.47	142.93	230	8	0.0498	2.70	1.74	no
E4-2	Taylor Avenue	27-425	116.01	131.47	230	8	0.0672	3.13	2.02	no
E4-2	Kimball Road	14-15	150.22	150.78	218	8	0.0026	0.61	0.40	no
E4-2	Kimball Road	15-13	149.26	150.22	220	8	0.0044	0.80	0.52	no
E4-2	Kimball Road	22-13	151.41	154.44	295	8	0.0103	1.22	0.79	no
E4-2	Kimball Road	23-24	150.66	152.94	212	8	0.0108	1.25	0.81	no
E4-2	Kimball Road	24-29	145.13	150.66	227	8	0.0244	1.89	1.22	no
E4-2	Beech Street	18-17	144.01	144.83	205	8	0.0040	0.76	0.49	no
E4-2	Beech Street	17-16	143.15	144.01	226	8	0.0038	0.75	0.48	yes
E4-2	Beech Street	16-19	142.87	143.15	98	8	0.0029	0.65	0.42	yes*
E4-2	Beech Street	19-20	142.05	142.87	193	8	0.0042	0.79	0.51	no

TABLE 3-3. CAPACITY ANALYSIS FOR SUBAREA E4-2

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E4-2	Beech Street	20-21	141.04	142.05	190	8	0.0053	0.88	0.57	no
E4-2	Beech Street	21-28	140.26	141.04	190	8	0.0041	0.77	0.50	yes
E4-2	Dresser Avenue	11-12	156.11	157.15	190	8	0.0055	0.89	0.58	no
E4-2	Dresser Avenue	12-13	149.26	156.11	192	8	0.0357	2.28	1.47	no
E4-2	Dresser Avenue	13-16	143.15	149.26	239	8	0.0256	1.93	1.25	yes*

Notes:

Lines that are shaded indicate sewers with less than minimum slope.

(1) The slope and flow capacity cannot be calculated due to a stub at the upstream end of the line.

* The potential bottleneck is due to the addition of flow from two or more upstream sewers.

TABLE 3-4. CAPACITY ANALYSIS FOR SUBAREA E5

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E5	East Street	24-23	107.02	110.89	247	12	0.0157	4.46	2.88	no
E5	East Street	23-22	98.86	99.44	169	12	0.0034	2.09	1.35	yes
E5	East Street	22-21	98.61	98.86	127	12	0.0020	1.58	1.02	yes*
E5	East Street	21-20	98.19	98.61	137	12	0.0031	1.97	1.27	no
E5	East Street	20-19	97.91	98.19	207	12	0.0014	1.31	0.85	yes*
E5	East Street	19-18	97.88	97.91	25	12	0.0012	1.23	0.80	no
E5	East Street	18-17	97.47	97.88	242	12	0.0017	1.47	0.95	no
E5	East Street	17-16	97.40	97.47	76	12	0.0009	1.08	0.70	yes*
E5	East Street	16-15	96.79	97.40	94	12	0.0065	2.87	1.85	no
E5	East Street	15-14	96.74	96.79	213	12	0.0002	0.55	0.35	yes
E5	East Street	14-13	96.51	96.74	169	12	0.0014	1.31	0.85	no
E5	East Street	13-12	96.20	96.51	130	12	0.0024	1.74	1.12	no
E5	East Street	12-11	96.05	96.20	128	12	0.0012	1.22	0.79	yes*
E5	East Street	11-10	95.93	96.05	132	12	0.0009	1.07	0.69	no
E5	East Street	10-9	95.85	95.93	175	12	0.0005	0.76	0.49	yes*
E5	East Street	9-8	95.65	95.85	86	12	0.0023	1.72	1.11	no
E5	East Street	8-7	95.54	95.65	161	12	0.0007	0.93	0.60	yes*
E5	East Street	7-6a	95.41	95.54	96	12	0.0014	1.31	0.85	no
E5	East Street	6a-6	95.29	95.41	101	12	0.0012	1.23	0.79	yes
E5	East Street	6-5	94.39	95.29	218	12	0.0041	2.29	1.48	no
E5	East Street	5-4	94.84	94.39	107	12	-0.0042	(1)	(1)	yes
E5	East Street	4-3	94.07	94.84	264	12	0.0029	1.92	1.24	no
E5	East Street	3-2	94.10	94.07	49	12	-0.0006	(1)	(1)	yes
E5	East Street	2-1	93.62	94.10	161	12	0.0030	1.94	1.26	no
E5	East Street	5-5a	97.91	98.66	22	8	0.0341	2.23	1.44	no
E5	East Street	10d-10c	97.36	97.29	68	8	-0.0010	(1)	(1)	yes
E5	East Street	10c-10b	96.01	97.33	128	8	0.0103	1.23	0.79	no
E5	East Street	10b-10a	96.60	95.99	190	8	-0.0032	(1)	(1)	yes
E5	East Street	10a-10a1	96.43	96.60	140	12	0.0012	1.24	0.80	no
E5	East Street	10a1-10	95.93	96.43	46	12	0.0109	3.71	2.40	no
E5	Top Hill Avenue	26a-26	112.77	129.60	150	8	0.1122	4.05	2.62	no
E5	Top Hill Avenue	26-25	98.84	112.77	142	8	0.0981	3.78	2.45	yes
E5	Top Hill Avenue	25-2	94.10	98.84	253	8	0.0187	1.65	1.07	no

TABLE 3-4. CAPACITY ANALYSIS FOR SUBAREA E5

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E5	Hermaine Avenue	28a-28	104.55	113.45	142	8	0.0627	3.02	1.95	no
E5	Hermaine Avenue	28-27	98.20	104.55	154	8	0.0412	2.45	1.59	yes
E5	Hermaine Avenue	27-3	97.29	98.20	148	8	0.0061	0.95	0.61	no
E5	Upland Road	26b-29e	130.78	131.32	85	8	0.0064	0.96	0.62	no
E5	Upland Road	29e-29d	121.44	130.78	155	8	0.0603	2.97	1.92	no
E5	Upland Road	29d-29c	106.71	121.44	240	8	0.0614	2.99	1.93	no
E5	Upland Road	29c-29a	103.44	106.71	58	8	0.0564	2.87	1.85	yes
E5	Upland Road	29a-29	102.69	103.44	220	8	0.0034	0.71	0.46	yes*
E5	Upland Road	29-4	101.73	102.69	318	8	0.0030	0.66	0.43	yes*
E5	Pine Grove Avenue	29f-29	102.69	103.59	262	8	0.0034	0.71	0.46	no
E5	Walters Avenue	29b-29a	103.44	109.42	267	8	0.0224	1.81	1.17	no
E5	Preston Street	32a-32	114.36	114.41	38	8	0.0013	0.44	0.28	no
E5	Preston Street	32-31	114.02	114.36	110	8	0.0031	0.67	0.43	no
E5	Preston Street	31-30	97.69	114.02	135	8	0.1210	4.20	2.72	no
E5	Preston Street	30-8	95.65	97.69	250	8	0.0082	1.09	0.71	yes
E5	Lamoine Street	34-33	99.03	118.08	150	8	0.1270	4.30	2.78	no
E5	Lamoine Street	33-10	95.93	99.03	174	8	0.0178	1.61	1.04	yes
E5	Norwich Street	12-12a	96.20	96.65	63	8	0.0071	1.02	0.66	yes
E5	Norwich Street	12a-12b	96.65	102.79	148	8	0.0415	2.46	1.59	no
E5	Southgate Street	37-36	112.38	123.62	179	8	0.0628	3.03	1.96	no
E5	Southgate Street	36-35	99.09	112.38	251	8	0.0529	2.78	1.80	yes
E5	Southgate Street	35-17	97.47	99.09	350	8	0.0046	0.82	0.53	no
E5	Malone Street	36d-36b	129.09	131.33	183	8	0.0122	1.34	0.86	no
E5	Mason Street	37a-36a	129.50	144.34	233	8	0.0637	3.05	1.97	no
E5	Ridgeway Street	44-43	124.17	128.63	50	8	0.0892	3.61	2.33	no
E5	Ridgeway Street	43-42	117.61	124.17	121	8	0.0542	2.81	1.82	yes
E5	Ridgeway Street	42-40	104.88	116.42	120	8	0.0962	3.75	2.42	yes*
E5	Ridgeway Street	40-50	101.64	104.88	117	8	0.0277	2.01	1.30	yes*
E5	Ridgeway Street	50-49	100.97	101.64	239	8	0.0028	0.64	0.41	no
E5	Ridgeway Street	49-48	99.98	100.97	240	8	0.0041	0.78	0.50	no
E5	Winstead Street	36c-36b	129.09	129.83	210	8	0.0035	0.72	0.46	no
E5	Winstead Street	36b-36a	128.55	129.09	247	8	0.0022	0.56	0.37	yes*
E5	Winstead Street	36a-41	118.03	128.55	143	8	0.0736	3.28	2.12	yes*

TABLE 3-4. CAPACITY ANALYSIS FOR SUBAREA E5

Subarea	Location	MH #s	Downstream Invert	Upstream Invert	Length (ft)	Diameter (in)	Slope (ft/ft)	Pipe Capacity @ n= 0.013		Potential Bottleneck
								(cfs)	(mgd)	
E5	Winstead Street	41-40	104.88	118.03	125	8	0.1052	3.92	2.53	no
E5	Granite Street	45-43	124.17	mh buried	207	8	(2)	(2)	(2)	?
E5	Creston Avenue	48a-48	99.98	100.41	97	8	0.0044	0.80	0.52	no
E5	Creston Avenue	48-38	99.33	99.98	199	8	0.0033	0.69	0.45	yes*
E5	Creston Avenue	39a-39	99.33	101.44	130	8	0.0162	1.54	0.99	no
E5	Carey Lane	42a-42	118.91	128.79	192	6	0.0515	1.27	0.82	no
E5	Sidney Street	38-20	98.19	99.33	261	8	0.0044	0.80	0.52	no
E5	Winfield Street	13a-23a	101.31	101.81	155	10	0.0032	1.24	0.80	no
E5	Winfield Street	23a-21	100.70	101.31	240	8	0.0025	0.61	0.39	yes
E5	Winfield Street	21-20a	100.11	100.70	239	10	0.0025	1.09	0.70	yes*
E5	Winfield Street	20a-39	99.33	100.11	239	12	0.0033	2.03	1.31	yes*
E5	Winfield Street	39-22	98.86	99.33	233	12	0.0020	1.60	1.03	no
E5	Alpena Avenue	20d-20a	100.11	101.92	272	8	0.0067	0.99	0.64	no
E5	Alpena Avenue	20b-20e	104.07	106.50	222	8	0.0109	1.26	0.82	no
E5	Alpena Avenue	20e-20a	100.65	104.07	100	8	0.0342	2.23	1.44	no
E5	Chester Avenue	21b-21a	101.60	102.90	202	8	0.0064	0.97	0.63	no
E5	Chester Avenue	21a-21	100.70	101.60	199	8	0.0045	0.81	0.53	yes
E5	Chester Avenue	22-21	100.70	101.94	271	8	0.0046	0.82	0.53	no
E5	Rosen Road	74.1-74.3	120.90	129.61	229	8	0.0380	2.36	1.52	no
E5	Judith Circle	74.9-74.8	120.48	126.22	137	8	0.0419	2.47	1.60	no
E5	Judith Circle	74.7-74.8	120.38	120.32	104	8	-0.0006	(1)	(1)	yes
E5	Cynthia Road	74.2-74.3	121.00	127.09	158	8	0.0385	2.37	1.53	no
E5	Cynthia Road	74.3-74.4	118.95	120.90	84	8	0.0232	1.84	1.19	yes*
E5	Cynthia Road	74.4-74.5	116.57	119.05	246	8	0.0101	1.21	0.78	no
E5	Cynthia Road	74.6-74.5	116.57	119.42	257	8	0.0111	1.27	0.82	no
E5	Cynthia Road Easement	74.8-74.5	116.57	120.28	356	8	0.0104	1.23	0.80	yes*
E5	Cynthia Road Easement	74.5-32a	114.41	116.57	213	8	0.0101	1.22	0.79	yes*

Notes:

Lines that are shaded indicate sewers with less than minimum slope.

(1) The flow capacity cannot be calculated using Manning's Equation due to the adverse slope of the existing sewer.

(2) The slope and flow capacity cannot be calculated due to missing information associated with the buried manhole.

* The potential bottleneck is due to the addition of flow from two or more upstream sewers.

sewers are more likely to have problems with sediment deposition and back-ups due to poor flow velocities. Figure 3-1 has been highlighted to show the sewers constructed at less than minimum slope. In subarea E5, this includes almost the entire length of the existing sewer on East Street as well as portions of the existing sewer on Upland Road to Preston Street, Ridgeway Street, Winstead Street, Creston Avenue, Winfield Street, and Judith Circle.

Review of Known Problem Areas. As noted earlier, the existing sewer on East Street (south of Rustcraft Road) is subject to surcharging during wet weather, peak flow conditions due to the bottleneck which exists at the downstream end of the existing sewer on Rustcraft Road. Further, as the level of surcharge increases along the length of East Street, there is the potential for service back-ups to occur in the vicinity of Norwich Street. This is another area with low-lying topography where the system can relieve itself under extreme high flow conditions.

To address the aforementioned problem, the town has since initiated the design of replacement sewers along Rustcraft Road to East Street, and on Hamilton Avenue and Glenway. This project is discussed further in the evaluation of alternatives presented in Section Four of this report.

SECTION FOUR
EVALUATION OF ALTERNATIVES

As summarized in Section Two of this report, there are numerous I/I sources and defects in need of repair based on the findings of the field investigations conducted throughout the Glenway/Hamilton Avenue study area. This section provides an overview of the various trenchless technology methods that are considered for the rehabilitation of sewers. In general, the use of a trenchless technology is preferred over traditional dig and replacement since it is less disruptive and less costly. However, there are many instances where the use of a trenchless technology is simply not feasible, and as a result, dig and replacement represents the only alternative available for the rehabilitation of the existing system. Following a review of the alternatives available for sewer rehabilitation, a summary of recommended sewer repairs is presented along with estimated costs.

This section also identifies and evaluates alternatives for addressing capacity limitations within the study area sewers. As summarized in Section Three, several areas are subject to flow related problems that are likely due to capacity limitations. A discussion of the alternatives available to the town to address these problem areas is presented in this section along with estimated costs.

SEWER REHABILITATION ALTERNATIVES

There are two general methodologies available for rehabilitating sewers; dig-and-replace and trenchless technologies. Dig-and-replace involves locating a defective pipe or pipe segment(s), excavating, and either repairing or replacing as necessary. Trenchless technologies require little or no excavation, as repairs are made internal to the existing pipe using manholes for access. These techniques may also be used to repair defective and leaking service connections.

Dig-and-Replace

Dig-and-replace is typically used when there are multiple pipe defects and/or the structural integrity of the sewer is in question. This method is used when either an entire sewer length

exhibits multiple defects such as cracks, separated joints or breaks, or when an individual pipe segment exhibits structural defects in which replacement of only that sewer segment is necessary.

Joint Testing and Sealing (Trenchless)

In the event of leaking or cracked joints, testing and sealing may be effective in reducing infiltration if the pipe is in structurally sound condition. Subsequent to hydraulic cleaning, each joint along the length of the sewer is pressure tested with air. If the joint fails the test, a chemical sealer is applied to prevent infiltration from entering the system from that source.

Internal Spot Repairs (Trenchless)

Where pipe is broken or cracked, spot repairs may be performed utilizing chemical grout, similar to joint sealing, or epoxy compounds for greater strength. Short cured-in-place liners or rigid sleeves may also be used for spot repair of more significant defects.

Root Control (Trenchless)

Trees and shrubs adjacent to sewer lines often cause damage to sewer pipes with their roots. The roots may enter the pipe by separating joints or, under extreme conditions, breaking pipe. The resultant openings allow infiltration to enter the sewer system. Further, the roots can block the pipe and restrict flow in the pipe. When this occurs, the roots may be removed by grinding and cutting. After removal, an herbicide is applied to kill the roots in the immediate vicinity of the pipe. Resultant root damage may be repaired with other trenchless technologies where appropriate.

Sewer Relining (Trenchless)

In sewer sections where there are multiple cracks, breaks and defective joints, it can be cost-effective to reline the pipe. Relining is an attractive alternative when conventional dig-and-

replace is too disruptive for a given location (i.e., a busy roadway) and/or when a sewer line is deep and only a minimum number of service connections are present. It should be noted, however, that this alternative cannot be used in sewer lines where pipe segments are collapsed. There are several proprietary methods available for relining. They range from mortar linings, which are spun onto the interior surface of the existing pipe, to tube liners such as Insituform®, which is a cured-in-place pipe relining technology.

RECOMMENDED SEWER REHABILITATION

As summarized previously in Table 2-2 of this report, numerous infiltration sources and defects were observed in the sewer pipelines, including joints either actively leaking or with evidence of previous leakage, structural defects such as broken or cracked pipe, and root intrusion. To repair these defects, it is recommended that the town implement the design and construction of sewer pipeline rehabilitation measures. Table 4-1 presents a detailed summary of the recommended sewer repairs in the Glenway/Hamilton Avenue study area. The table is organized by subarea and alphabetically by street name. For completeness, the recommendations from previous TV inspection work conducted within the study area by either the town or Metcalf & Eddy have also been incorporated in this table. Figure 4-1 has been highlighted to show the recommended repairs for each sewer identified with defects requiring rehabilitation.

As indicated, the recommended sewer repairs generally include joint testing and chemical sealing, chemical treatment for root control, and spot repairs of structural defects using short liners, chemical grout, or epoxy resins. Both the joint testing and sealing and root control work are fairly straightforward. However, the spot repair work is more complex due to the variety of repair methods that can be used, including short liners, chemical grout and epoxy resins. The total estimated cost of the sewer pipeline repairs, including an allowance for engineering and contingencies, is approximately $1,065,000. These repairs should be undertaken as a single rehabilitation contract since they are typically completed by a pipeline services company.

In addition to the aforementioned sewer defects, approximately 4,175 feet of sewer have significant defects that warrant more substantial repairs such as excavation and replacement or

TABLE 4-1. SUMMARY OF SEWER REHABILITATION RECOMMENDATIONS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Sewer Pipeline Rehabilitation							Rehabilitation of Services			
								Clean (ft)	Root Control (ft)	Joint T&S (ft)	Localized Spot Repair (#)	Lineal Spot Repair (ft)	Full Liner (ft)	Replace (ft)	Cut & Grout (#)	Cut (#)	Seal & Retest (#)	Dig & Replace (#)
E3-2	2	40	39A	Allied Drive	95	12	none											
E3-2	2	41	40	Allied Drive	212	12	none											
E3-2	2	42	41	Allied Drive	132	12	none											
E3-2	1	43	42A	Allied Drive	298	8	minor		298	298		9						
E3-2	5	49	49.1	Allied Drive Easement	85	10	major							85				
E3-2	1	50	49	Allied Drive Easement	141	12	none											
E3-2	1	51	50A	Allied Drive Easement	60	12	none											
E3-2	1	59	67	Allied Drive Easement	131	8	minor		131	131								
E3-2	1	67	68	Allied Drive Easement	60	10	none											
E3-2	1	68	69	Allied Drive Easement	198	12	none											
E3-2	1	69	70	Allied Drive Easement	78	12	none											
E3-2	1	70	71	Allied Drive Easement	184	12	minor				1							
E3-2	1	71	51	Allied Drive Easement	198	12	none											
E3-2	1	39A	39	Allied Drive Easement	182	12	none											
E3-2	1	50A	50	Allied Drive Easement	97	12	none											
E3-2	1	1	2	Elm Street	193	8	minor			193							1	
E3-2	1	2	3	Elm Street	169	8	minor			169	2							
E3-2	1	3	4	Elm Street	169	8	minor								1			
E3-2	1	4	5	Elm Street	169	8	minor								1			
E3-2	1	6	5	Elm Street	49	8	none											
E3-2	1	7	6	Elm Street	198	8	none											
E3-2	2	8	9	Elm Street	95	8	none											
E3-2	2	8	7	Elm Street	246	8	minor										1	1
E3-2	2	5	5A	Elm Street Easement	32	8	incomplete											
E3-2	2	16	17	Elm Street Easement	111	12	none											
E3-2	2	5A	15A	Elm Street Easement	220	8	incomplete											
E3-2	1	10	6	Robinwood Road	252	8	minor								2			
E3-2	1	11	10	Robinwood Road	293	8	minor		293	293					3		1	
E3-2	1	12	11	Robinwood Road	180	8	minor		180	180							1	
E3-2	1	13	12	Robinwood Road	270	8	minor			270					2			
E3-2	1	14	13	Robinwood Road	52	8	none											
E3-2	2	20	22	Rustcraft Road	280	12	none											
E3-2	1	21	20	Rustcraft Road	102	12	none											
E3-2	2	22	23	Rustcraft Road	192	12	minor					4						
E3-2	2	23	24	Rustcraft Road	368	12	none											
E3-2	1	24	24A	Rustcraft Road	108	12	none											
E3-2	2	26	26A	Rustcraft Road	160	12	none											
E3-2	2	27	28	Rustcraft Road	233	12	moderate							20				
E3-2	2	28	29	Rustcraft Road	233	12	none											
E3-2	2	29	30	Rustcraft Road	233	12	none											

TABLE 4-1. SUMMARY OF SEWER REHABILITATION RECOMMENDATIONS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Sewer Pipeline Rehabilitation							Rehabilitation of Services			
								Clean (ft)	Root Control (ft)	Joint T&S (ft)	Localized Spot Repair (#)	Lineal Spot Repair (ft)	Full Liner (ft)	Replace (ft)	Cut & Grout (#)	Cut (#)	Seal & Retest (#)	Dig & Replace (#)
E3-2	2	30	31	Rustcraft Road	176	12	none											
E3-2	2	31	32	Rustcraft Road	175	12	none											
E3-2	2	32	33	Rustcraft Road	175	12	none											
E3-2	2	33	34	Rustcraft Road	161	12	none											
E3-2	2	34	35	Rustcraft Road	248	12	minor		248	248								
E3-2	2	35	36	Rustcraft Road	187	12	minor											
E3-2	1	24A	26	Rustcraft Road	174	12	none											
E3-2	2	26A	27	Rustcraft Road	174	12	moderate							174				
E3-2	1, 2	17	18	Rustcraft Road Easement	263	12	none											
E3-2	1	18	19	Rustcraft Road Easement	303	12	none											
E3-2	1	19	19A	Rustcraft Road Easement	161	12	none											
E3-2	1	19A	20	Rustcraft Road Easement	54	12	none											
E3-2	1	55	56	Willard Street	113	8	minor								1			
E3-2	1	56	57	Willard Street	246	8	minor								1			
E3-2	1	57	58	Willard Street	94	8	minor								1			
E3-2	1	58	59	Willard Street	46	8	none											
E3-2	1	59	60	Willard Street	48	8	minor								1			
E3-2	1	60	61	Willard Street	75	8	none											
E3-2	1	61	62	Willard Street	72	8	minor				1							
E3-2	1	62	63	Willard Street	151	8	minor								1			
E3-2	1	63	64	Willard Street	64	8	minor			64								
E3-2	1	64	65	Willard Street	72	8	minor			72	1							
E3-2	1	65	66	Willard Street	122	8	none											
E4-1	5	47	48	Adams Street	145	8	minor		145	145						2		2
E4-1	5	48	49	Adams Street	123	8	minor		123	123						1	1	
E4-1	5	49	53	Adams Street	250	8	moderate				3	6						1
E4-1	5	53	53.1	Adams Street	92	8	moderate			92		3						
E4-1	5	56	53.1	Adams Street	194	8	minor				1							1
E4-1	5	80	81	Adams Street	221	8	moderate		221	221								4
E4-1	1	81	82	Adams Street	267	8	moderate		267	267	1				1			1
E4-1	5	89	90	Adams Street	220	8	incomplete									1	1	
E4-1	5	90	91	Adams Street	280	8	minor		280	280								2
E4-1	5	6	7	Boulevard Road	274	8	minor		274	274								2
E4-1	5	7	8	Boulevard Road	278	8	moderate				2	3					1	1
E4-1	1*	8	9	Boulevard Road	269	8	moderate		269	269					4			
E4-1	1	9	5	Boulevard Road	262	8	minor											
E4-1	5	27	25	Circuit Road	297	8	minor									2		
E4-1	5	27	30	Circuit Road	284	8	minor										1	
E4-1	5	30	32	Circuit Road	283	8	minor		283	283						2	2	2

TABLE 4-1. SUMMARY OF SEWER REHABILITATION RECOMMENDATIONS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Sewer Pipeline Rehabilitation							Rehabilitation of Services			
								Clean (ft)	Root Control (ft)	Joint T&S (ft)	Localized Spot Repair (#)	Lineal Spot Repair (ft)	Full Liner (ft)	Replace (ft)	Cut & Grout (#)	Cut (#)	Seal & Retest (#)	Dig & Replace (#)
E4-1	1	3	4	East Street	234	8	minor		234	234	2							
E4-1	1*	4	4A	East Street	18	8	none											
E4-1	1	5	10	East Street	211	8	none											
E4-1	1	10	11	East Street	212	8	minor				1							
E4-1	1	23	11	East Street	178	10	none											
E4-1	1	44	23	East Street	180	10	minor				1				1			
E4-1	1	44	45	East Street	178	12	minor			178								
E4-1	5	45	46	East Street	156	10	minor			156								
E4-1	5	79	46	East Street	285	12	moderate			285		9						1
E4-1	1*	82	79	East Street	76	12	none											
E4-1	1*	98	82	East Street	346	12	moderate											
E4-1	5	98	99	East Street	225	12	minor	225								1		
E4-1	5	882	99	East Street	101	12	none											
E4-1	1	99	100	East Street	205	12	none											
E4-1		1	100	East Street	195	12	minor	195		195					1			
E4-1	1	4A	5	East Street	90	8	minor			90	1							
E4-1	1	41	70	Elmwood Avenue	336	8	minor		336	336					1			
E4-1	1	42	41	Elmwood Avenue	258	8	minor		258	258					2			
E4-1	1	92	91	Elmwood Avenue	242	8	major						242		1		1	
E4-1	1	93	96	Elmwood Avenue	175	8	moderate		175	175	2	3		10			1	
E4-1	1**	93	91	Elmwood Avenue	174	8	moderate		174	174		7						1
E4-1	5	31	30	Fales Road	204	8	minor									1		1
E4-1	5	74	73	Ford Street	232	8	minor		232	232						1	2	
E4-1	5	75	74	Ford Street	51	8	minor					3						
E4-1	5	76	75	Ford Street	122	8	none											
E4-1	1	84	83	Glenway	265	8	incomplete											
E4-1	1**	67	66	Grant Avenue	282	8	minor		282	282	2				1			
E4-1	1**	94	95	Grant Avenue	245	8	minor		245	245	2				1			
E4-1	1**	95	96	Grant Avenue	247	8	minor		247	247								
E4-1	1**	96	97	Grant Avenue	255	8	minor		255	255	1							
E4-1	5	97	98	Grant Avenue	271	8	minor				1							
E4-1	5	26A	26	Greenwood Avenue	308	8	moderate				3			10		1		1
E4-1	1	26	99	Greenwood Avenue	176	8	none											
E4-1	1	84	79	Hamilton Avenue	270	8	minor											
E4-1	1	85	84	Hamilton Avenue	236	8	moderate											
E4-1	1	86	85	Hamilton Avenue	74	8	minor											
E4-1	1	87	86	Hamilton Avenue	199	8	minor											
E4-1	5	58	57	Jefferson Street	100	6	incomplete							100				
E4-1	5	58	60	Jefferson Street	315	8	minor		315	315						2	1	2
E4-1	5	60	61	Jefferson Street	309	8	moderate			309		4		10				

TABLE 4-1. SUMMARY OF SEWER REHABILITATION RECOMMENDATIONS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Sewer Pipeline Rehabilitation							Rehabilitation of Services			
								Clean (ft)	Root Control (ft)	Joint T&S (ft)	Localized Spot Repair (#)	Lineal Spot Repair (ft)	Full Liner (ft)	Replace (ft)	Cut & Grout (#)	Cut (#)	Seal & Retest (#)	Dig & Replace (#)
E4-1	5	61	62	Jefferson Street	308	8	minor		308	308								
E4-1	1*	62	68	Jefferson Street	221	8	minor		221	221								
E4-1	1*	68	69	Jefferson Street	210	8	minor											
E4-1	1*	69	70	Jefferson Street	210	8	none											
E4-1	1	70	71	Jefferson Street	212	8	minor		212	212	1							
E4-1	1	71	72	Jefferson Street	212	8	moderate		212	212	1	11			2		2	
E4-1	1	72	46	Jefferson Street	213	8	moderate											
E4-1	5	24	59	Jefferson Street Easement	250	8	incomplete									1		
E4-1	5	58	59	Jefferson Street Easement	150	8	incomplete		150	150								
E4-1	5	54	53	Lilly Lane	285	6	incomplete							285				
E4-1	5	54	55	Lilly Lane	292	6	minor	292								1	3	
E4-1	1*	25	24	Madison Street	285	8	minor											
E4-1	1	26	24	Madison Street	167	8	minor		167	167								
E4-1	1	33	34	Madison Street	251	8	moderate			251					4			1
E4-1	1	34	35	Madison Street	234	8	moderate			234	1			30				1
E4-1	1	35	36	Madison Street	221	8	minor		221	221	1			10				
E4-1	1	39	40	Madison Street	291	8	minor		291	291		9			1			
E4-1	1	40	41	Madison Street	293	8	major							293				
E4-1	1	41	43	Madison Street	323	8	minor											
E4-1	1	43	44	Madison Street	322	8	minor		322	322	1				1			
E4-1	5	12	12.1	Madison Street Easement	50	8	minor			50								
E4-1	5	24	12.1	Madison Street Easement	302	8	minor		302	302								
E4-1	1	13	12	Monroe Street	180	8	moderate			180	2				1			2
E4-1	1	14	15	Monroe Street	226	8	major		226	226	3			65				1
E4-1	1	15	16	Monroe Street	228	8	moderate		228	228	3				1			
E4-1	5	16	19	Monroe Street	204	8	none											
E4-1	5	19	20	Monroe Street	233	8	minor				1					1	1	
E4-1	5	20	21	Monroe Street	232	8	minor									2	1	
E4-1	5	21	22	Monroe Street	280	8	minor									1	1	1
E4-1	1	22	11	Monroe Street	273	8	minor											
E4-1	5	36	38	Mount Vernon Street	176	8	minor				1	3						
E4-1	5	63	62	Mount Vernon Street	203	8	minor				1	3		20		1		
E4-1	5	64	63	Mount Vernon Street	142	8	minor									1		
E4-1	5	65	64	Mount Vernon Street	261	8	minor									1		
E4-1	5	66	65	Mount Vernon Street	95	8	none											
E4-1	5	38	62	Mount Vernon Street	167	8	none											
E4-1	5	17	18	Mt. Vernon Street	283	8	minor					3						
E4-1	5	18	16	Mt. Vernon Street	282	8	minor		282	282						1	1	
E4-1	1	37	36	Mt. Vernon Street	120	8	moderate		120	120	1				2			1
E4-1	5	50	49	Netta Road	150	8	none											

TABLE 4-1. SUMMARY OF SEWER REHABILITATION RECOMMENDATIONS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Sewer Pipeline Rehabilitation							Rehabilitation of Services			
								Clean (ft)	Root Control (ft)	Joint T&S (ft)	Localized Spot Repair (#)	Lineal Spot Repair (ft)	Full Liner (ft)	Replace (ft)	Cut & Grout (#)	Cut (#)	Seal & Retest (#)	Dig & Replace (#)
E4-1	5	51	50	Netta Road	154	8	minor		154	154						1	1	1
E4-1	5	51	52	Netta Road	148	8	minor		148	148						1	1	1
E4-1	2	46	73	Rustcraft Road	216	18	moderate											
E4-1	2	73	77	Rustcraft Road	193	18	moderate											
E4-1	2	77	77A	Rustcraft Road	198	18	none											
E4-1	2	77A	77B	Rustcraft Road	250	18	minor											
E4-1	2	77B	180	Rustcraft Road	314	18	moderate											
E4-1	5	1	2	Sanderson Avenue	307	8	moderate		307	307		4						1
E4-1	1	2	3	Sanderson Avenue	313	8	minor		313	313								1
E4-1	5	56	57	Shiretown Road	250	8	incomplete									1		
E4-1	5	27	28	Wood Road	122	8	minor		122	122								
E4-1	5	28	29	Wood Road	203	8	minor				1					1		
E4-2	5	16	19	Beech Street	101	8	none											
E4-2	5	17	16	Beech Street	230	8	none											
E4-2	5	18	17	Beech Street	208	8	moderate		208	208		5					1	1
E4-2	5	19	20	Beech Street	194	8	minor				1	3				1	1	
E4-2	5	20	21	Beech Street	192	8	minor		192	192								1
E4-2	5	21	28	Beech Street	191	8	moderate					10						
E4-2	5	28	stub	Cedar Street	130	8	incomplete	130										
E4-2	5	29	28	Cedar Street	249	8	none											
E4-2	5	29	34	Cedar Street	246	8	major							246				
E4-2	5	34	414	Cedar Street	217	8	major							217				
E4-2	1	414	425	Cedar Street	199	8	minor		199	199	1	6						
E4-2	1	425	441	Cedar Street	175	8	moderate		175	175	4				1			1
E4-2	1	441	455	Cedar Street	171	8	moderate											
E4-2	5	11	12	Dresser Avenue	195	8	moderate				3	14		22				
E4-2	5	12	13	Dresser Avenue	198	8	major						198	10				1
E4-2	5	16	13	Dresser Avenue	242	8	moderate		242	242		3						
E4-2	5	14	15	Kimball Road	222	8	moderate					6				4	3	
E4-2	5	15	13	Kimball Road	222	8	moderate				1	3		10				
E4-2	5	22	13	Kimball Road	301	8	minor				2							2
E4-2	5	23	24	Kimball Road	215	8	minor				2					1		
E4-2	5	24	29	Kimball Road	226	8	minor				2					1		1
E4-2	5	35	36	Nobel Street	180	8	minor				1	3						
E4-2	5	36	37	Nobel Street	202	8	minor		202	202						1		
E4-2	1	32	455	Sprague Street	197	8	moderate			197		6			1			1
E4-2	5	37	38	Sprague Street	148	8	minor				3	3						
E4-2	5	37	39	Sprague Street	285	8	minor				1					3		
E4-2	5	39	40	Sprague Street	147	8	minor					3				1		
E4-2	5	40	41	Sprague Street	265	8	minor					3						

TABLE 4-1. SUMMARY OF SEWER REHABILITATION RECOMMENDATIONS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Sewer Pipeline Rehabilitation							Rehabilitation of Services			
								Clean (ft)	Root Control (ft)	Joint T&S (ft)	Localized Spot Repair (#)	Lineal Spot Repair (ft)	Full Liner (ft)	Replace (ft)	Cut & Grout (#)	Cut (#)	Seal & Retest (#)	Dig & Replace (#)
E4-2	5	41	66	Sprague Street	251	10	moderate			251		3				3		2
E4-2	5	50	32	Sprague Street	189	10	moderate			189		3				2	1	1
E4-2	1	66	50	Sprague Street	247	8	moderate			247	3				2			
E4-2	1	455	884	Sprague Street	103	12	moderate			103				10				
E4-2	1	884	882	Sprague Street	104	12	none											
E4-2	5	10	9	Taylor Avenue	311	8	moderate		277	277		3				3	3	
E4-2	5	10	11	Taylor Avenue	144	8	major						144					
E4-2	5	24	25	Taylor Avenue	233	8	minor					6				2	2	
E4-2	5	25	26	Taylor Avenue	234	8	minor		234	234						2	2	1
E4-2	5	26	27	Taylor Avenue	233	8	minor					3					1	
E4-2	5	27	425	Taylor Avenue	234	8	major						234	11				
E5	5	20B	20A	Alpena Avenue	276	6	minor					6						
E5	5	20C	20A	Alpena Avenue	101	8	minor		101	101						1	1	
E5	5	20D	20C	Alpena Avenue	227	8	major						227	11				1
E5	1**	22	21	Chester Avenue	268	8	minor										1	
E5	5	21A	21	Chester Avenue	204	8	minor				1						1	1
E5	5	21B	21A	Chester Avenue	205	8	moderate					3		10		1	2	1
E5	5	39	39A	Creston Avenue	135	8	minor		135	135								
E5	5	48	38	Creston Avenue	202	8	minor				1	4						
E5	5	48	48A	Creston Avenue	98	8	minor		98	98								
E5	5	74.3	74.2	Cynthia Road	158	8	minor										1	
E5	5	74.3	74.4	Cynthia Road	84	8	none											
E5	5	74.4	74.5	Cynthia Road	246	8	minor										1	
E5	5	74.5	74.6	Cynthia Road	257	8	minor					3					3	
E5	5	74.5	32	Cynthia Road Easement	220	8	none											
E5	1	1	2	East Street	163	12	minor			163								
E5	1	10	11	East Street	129	12	minor			129								
E5	1	11	12	East Street	126	12	minor			126								
E5	1	12	13	East Street	127	12	minor			127								
E5	1	13	14	East Street	126	12	moderate											
E5	1	14	15	East Street	262	12	major											
E5	1	15	16	East Street	98	12	minor			98								
E5	1	16	17	East Street	79	12	minor			79								
E5	1	17	18	East Street	246	12	minor			246	2							
E5	1	18	19	East Street	27	12	none											
E5	1	19	20	East Street	209	12	minor			209								
E5	1	2	3	East Street	51	12	minor			51								
E5	1	20	21	East Street	270	12	major											
E5	1	21	22	East Street	130	12	major											
E5	1	22	23	East Street	172	12	major											

TABLE 4-1. SUMMARY OF SEWER REHABILITATION RECOMMENDATIONS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Sewer Pipeline Rehabilitation							Rehabilitation of Services			
								Clean (ft)	Root Control (ft)	Joint T&S (ft)	Localized Spot Repair (#)	Lineal Spot Repair (ft)	Full Liner (ft)	Replace (ft)	Cut & Grout (#)	Cut (#)	Seal & Retest (#)	Dig & Replace (#)
E5	1	23	24	East Street	249	12	major											
E5	1	3	4	East Street	263	12	moderate			263		37					1	
E5	1	4	5	East Street	109	12	minor			109		28						
E5	1	5	6	East Street	213	12	major											
E5	1	6	7	East Street	201	12	major											
E5	1	7	8	East Street	167	12	minor											
E5	1	8	9	East Street	86	12	minor			86								
E5	1	9	10	East Street	177	12	minor			177								
E5	5	10d	10c	East Street	71	8	none											
E5	5	10c	10b	East Street	130	8	major				1			13				
E5	5	10b	10a	East Street	194	8	minor					7						
E5	5	10a	10a1	East Street	142	8	none											
E5	5	10a1	10	East Street	45	8	none											
E5	5	43	45	Granite Street	207	8	moderate				1			10		2		
E5	1	27	28	Hermaine Aveune	154	8	minor			154								
E5	1	3	27	Hermaine Aveune	151	8	minor			151		31						
E5	5	28A	28A1	Hermaine Aveune	118	8	minor		118	118						1	1	
E5	5	28A	28	Hermaine Aveune	148	8	minor		148	148						3		
E5	5	74.8	74.7	Judith Circle	104	8	none											
E5	5	74.8	74.9	Judith Circle	137	8	none											
E5	5	74.8	74.5	Judith Circle Easement	356	8	minor					3						
E5	1	10	33	Lamoine Street	178	8	minor			178								
E5	1	33	34	Lamoine Street	154	8	major							154				
E5	5	36B	36D	Malone Street	185	8	moderate		185	185				10				
E5	5	36A	37A	Mason Street	236	8	minor		236	236	1					1	1	
E5	5	23A	13A	Overlook Avenue	156	8	minor		156	156							1	2
E5	5	29	29F	Pine Grove Avenue	268	8	major							268				
E5	1	30	31	Preston Street	141	8	minor			141		11						
E5	1	31	32	Preston Street	117	8	minor			117								
E5	1	8	30	Preston Street	252	8	minor											
E5	5	40	50	Ridgeway Street	119	8	minor				1					1		
E5	5	42	40	Ridgeway Street	123	8	minor					3				3	2	
E5	5	43	42	Ridgeway Street	123	8	moderate							10		2		
E5	5	43	44	Ridgeway Street	52	8	major							52				
E5	5	74.3	74.1	Rosen Road	229	8	none											
E5	1	20	38	Sidney Street	266	8	minor			266								
E5	1	17	35	Southgate	352	8	moderate			352		31						
E5	1	35	36	Southgate	236	8	moderate			236		21						
E5	1	36	37	Southgate	184	8	minor			184							1	
E5	1	2	25	Top Hill Avenue	258	8	major											

TABLE 4-1. SUMMARY OF SEWER REHABILITATION RECOMMENDATIONS IN THE GLENWAY/HAMILTON AVENUE STUDY AREA

Sewer Sub area	Report	From MH	To MH	Street Name	Pipe Length (ft)	Pipe Dia (in)	Defect Severity	Sewer Pipeline Rehabilitation							Rehabilitation of Services			
								Clean (ft)	Root Control (ft)	Joint T&S (ft)	Localized Spot Repair (#)	Lineal Spot Repair (ft)	Full Liner (ft)	Replace (ft)	Cut & Grout (#)	Cut (#)	Seal & Retest (#)	Dig & Replace (#)
E5	1	25	26	Top Hill Avenue	145	8	minor		145	145								
E5	5	29E	26A	Top Hill Avenue	297	8	moderate		297	297		5		10		3	1	1
E5	5	26A	26	Top Hill Avenue	154	8	minor									2	1	
E5	5	29A	29	Upland Road	223	8	moderate				2	7				2		
E5	5	29A	29C	Upland Road	58	8	minor				1	3						
E5	5	29D	29C	Upland Road	246	8	moderate					7		10		2		
E5	5	29E	29D	Upland Road	158	8	major						158					
E5	5	29E	stub	Upland Road	101	10	moderate							10				2
E5	1	4	29	Upland Road	325	8	minor			325								
E5	5	29A	29B	Walters Avenue	271	8	moderate					20				2		
E5	5	21	20A	Winfield Street	242	10	major							242				
E5	5	20A	39	Winfield Street	243	10	major							243				
E5	1	22	39	Winfield Street	235	10	major											
E5	5	23A	21	Winfield Street	244	10	major							244				
E5	5	40	41	Winstead Avenue	128	8	minor		128	128						1		
E5	5	49	48	Winstead Avenue	243	8	moderate					14				4	3	
E5	5	50	49	Winstead Avenue	243	8	moderate							10		1	1	
E5	5	36A	41	Winstead Avenue	146	8	moderate		146	146		11						
E5	5	36B	36A	Winstead Avenue	251	8	moderate		251	251		6		10		2	1	
E5	5	36B	36C	Winstead Avenue	214	8	moderate				1	12		11		3	2	
							Total =	842	13,944	21,686	82	443	1,203	2,966	43	89	66	54
							Unit Cost =	$5.00	$1.75	$8.50	$250.00	$1,200.00	$50.00	varies[1]	$950.00	$600.00	$350.00	$1,500.00
							Subtotal Cost[2] =	$4,210	$24,402	$184,331	$20,500	$531,600	$60,150	$623,000	$40,850	$53,400	$23,100	$81,000
								$4,210				$760,833	$60,150	$623,000			$117,350	$81,000

Notes:

(1) For pipe replacement of manhole to manhole sewer reaches, a unit cost of $200 was used. For pipe replacement of short sections of sewer (i.e., 10 to 30 feet in length), a unit cost of $300 was used.

(2) The estimated costs for the recommended sewer pipeline rehabilitation program which are referenced in the report were determined as follows:

Sewer pipeline rehabilitation includes the cost for root control, joint testing and sealing, and spot repairs plus and allowance for engineering and contingency =	$1,066,000
Sewer replacement includes the cost of digging and replacing pipe plus an allowance for engineering and contingency =	$873,000
Sewer relining includes the cost for relining pipe plus an allowance for engineering and contingency =	$85,000
Pipe cleaning cost is approximately =	$6,000
Rehabilitation of services includes the cost of cutting, sealing and testing services plus an allowance for engineering and contingency =	$165,000
Replacement of services includes the cost of digging and replacing services plus an allowance for engineering and contingency =	$114,000

Lines that are shaded have been/will be replaced/rehabilitated under separate contracts.

Report 1 - 1998 TV Inspection Report

Report 1* - 1998 TV Inspection Report sewers previously television inspected by M&E between 1992-1994

Report 1** - 1998 TV Inspection Report sewers television inspected by Araco under separate contract to the town

Report 2 - Jan. 1999

Report 5 - Manor Study


E1-1
E3-1
E4-1
E4-2
D1-2
D2-1
D2-3
D2-2
E5
E3-2
Rustin Pond
LEGEND
45 Manhole With Manhole Number
54 Manhole With Street Address
MWRA Interceptors
Town of Dedham Sewer
Sewer Sub-Area Boundary
Glenway/Hamilton Avenue Study Area
Right of Way
Corporate Boundary
Street Edge
Rail Lines
Sewers Requiring Lining
Sewers Requiring Partial or Full Manhole To Manhole Replacement
Sewers Requiring Trenchless Rehabilitation (i.e. Root Control, Joint Testing and Sealing, and Structural Spot Repairs)
800 0 800
SCALE IN FEET
TOWN OF DEDHAM, MASSACHUSETTS
FIGURE 4-1. SEWERS WITH DEFECTS REQUIRING REHABILITATION
M&E
Metcalf & Eddy
sewr_regrehab11x17.aml

lining of the existing sewer. These repairs are normally completed by either a general contractor, if replacement is the selected rehabilitation method, or by a specialized pipe lining firm, if lining is the selected method. The total estimated cost for replacing sewers, including an allowance for engineering and contingencies, is approximately $872,000. The total estimated cost of lining, including an allowance for engineering and contingencies, is approximately $84,000. Due to the economy of scale, it would be more cost effective for the town to combine the recommended lining work for this study area with other recommended lining work in either the Manor study area or other areas of town.

Table 4-1 has been highlighted with shading to show where replacement work will be performed under the proposed Glenway/Hamilton Avenue construction contract discussed later in this section or where rehabilitation work has already been performed by the town since the time the original TV inspection work was conducted. In addition, there are a number of sewers that could not be fully inspected due to root blockages, collapsed pipe, protruding service connections, or severe pipe sags which blocked the progression of the camera. This is noted in the defect severity column of Table 4-1 where sewers that could not be fully inspected are labeled as incomplete. These sewers require repairs such as root treatment, cutting back a protruding service connection, or replacement of a collapsed section to open the line to allow for the passage of the television camera to complete inspection of the line. Where appropriate, recommendations to this effect have been included in Table 4-1.

Table 4-1 also includes recommendations for the rehabilitation of lateral service connections by cutting and/or sealing and testing services or by digging and replacing. Since the cutting and/or sealing of services is performed from within the main line sewer, it is recommended that this work be included as part of a sewer pipeline rehabilitation contract. The lateral service connections which require replacement would be included in a dig and replace contract for sewers. The total estimated costs of rehabilitating services under the two separate contracts, including allowances for engineering and contingencies, are approximately $164,000 and $113,500, respectively. Figure 4-2 has been highlighted to show the recommended repairs for sewers with services that have defects requiring rehabilitation.

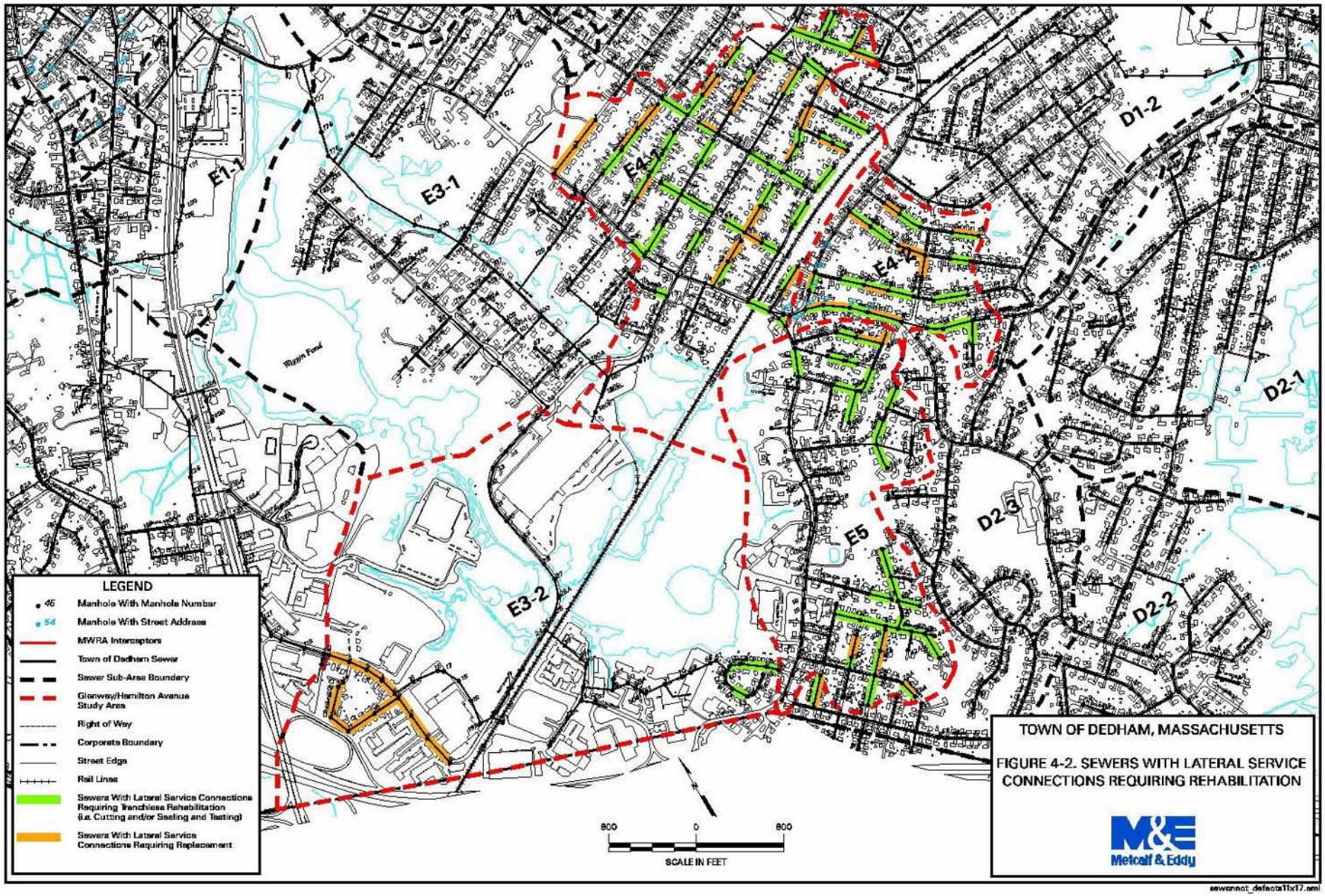
SEWER CAPACITY ALTERNATIVES

The alternatives available to increase flow capacity generally include constructing either new replacement or relief sewers, identifying and removing private inflow sources, and implementing routine operation and maintenance (O&M) procedures. These alternatives would be in addition to any sewer rehabilitation work recommended above.

New Replacement or Relief Sewers

New replacement or relief sewers would be constructed to provide additional capacity to convey peak flows during wet weather conditions. These sewers would be sized accordingly, and designed to meet minimum criteria established for pipe slope and depth of cover. However, when the upstream and downstream inverts are fixed (i.e. no drop inlet, no end manhole, etc.), replacement with a larger sized pipe at the same elevation may not necessarily eliminate the problem(s). As a result, there may be existing low-lying areas where consideration would be given to the installation of a pump station and force main in lieu of a gravity system that may already exist. However, this determination would be based on evaluation of site specific conditions and comparison of both capital and annual O&M costs.

As summarized in Section Three of this report, there are two areas that are subject to flow related problems that are likely due to the existing sewers being constructed with less than minimal slope and/or depth of cover. The first area is located in subarea E3-2, and includes the sewer on Rustcraft Road between Elm Street and the East Brook Replacement Interceptor (EBRI) at McKinley Avenue. The second area is located in subareas E4-1 and E5, and includes the sewers on East Street and Rustcraft Road between Route 95 and the terminus of the EBRI. The latter area also includes the sewers on Glenway and Hamilton Avenue. Specific recommendations to address the capacity problems in these areas are discussed later in this section.


E1-1
E3-1
E4-1
E4-2
D1-2
D2-1
D2-3
D2-2
E5
E3-2
Rustin Pond
LEGEND
46 Manhole With Manhole Number
54 Manhole With Street Address
MWRA Interceptors
Town of Dedham Sewer
Sewer Sub-Area Boundary
Glenway/Hamilton Avenue Study Area
Right of Way
Corporate Boundary
Street Edge
Rail Lines
Sewers With Lateral Service Connections Requiring Trenchless Rehabilitation (i.e. Cutting and/or Sealing and Testing)
Sewers With Lateral Service Connections Requiring Replacement
800
0
800
SCALE IN FEET
TOWN OF DEDHAM, MASSACHUSETTS
FIGURE 4-2. SEWERS WITH LATERAL SERVICE CONNECTIONS REQUIRING REHABILITATION
M&E
Metcalf & Eddy
sewconnst_defects11x17.eml

Private Inflow Sources

Through previous I/I and SSES investigations, the town of Dedham has identified numerous private sources of inflow to its sanitary sewer system, such as sump pumps, roof leaders, and yard/driveway drains. Although the town's sewer ordinance prohibits any type of connection that allows stormwater runoff to enter the system, it has not been strictly enforced. However, it should be noted that the inflow entering the system through these sources may be a contributing factor to the flow related problems that occur within the study area sewers during wet weather conditions. At this time, therefore, it may be prudent for the town to consider developing a program to identify and remove private sources of inflow from the sanitary sewer system. This program could be modeled after the various programs that have been utilized by other Massachusetts communities. The MWRA may also serve as a valuable resource for the town to take advantage of in developing such a program.

Routine O&M Procedures

Based on the results of the capacity analysis presented in Section Three, there are many sewers within the study area that have been constructed at slopes less than the minimum typically used in the design of sanitary sewers. Although only a small percentage of the total number of sewers experience flow related problems that require corrective action, the balance of these sewers should be given priority when conducting routine O&M procedures. Because these sewers are more likely to experience flow related problems, the town should implement a program of cleaning the sewers and inspecting the manholes for evidence of surcharging on a regular basis. Additionally, the town should consider replacing the sewers in these streets whenever excavation or reconstruction is proposed and there is the opportunity to improve the flow conditions within the sewer by increasing the slope, depth of cover, or size of the pipe.

RECOMMENDED SEWER CAPACITY IMPROVEMENTS

As noted earlier, there are two areas that are subject to flow related problems on a recurring basis that are likely due to the existing sewers being constructed with less than minimal slope and/or

depth of cover. Following is a discussion of the sewer capacity improvements recommended specifically for these areas.

Rustcraft Road Sewer

The existing sewer on Rustcraft Road, between Elm Street and the EBRI at McKinley Avenue, is a good example of where replacement with a pump station and force main may be required in lieu of the gravity system that already exists. Over the long term, the cost to install and operate a pump station and force main is generally higher than the cost to construct a new gravity sewer. However, the selection of one alternative versus the other may be governed by site specific conditions.

According to record plan information, a portion of the existing sewer on Rustcraft Road is constructed on a pile foundation. Previous TV inspection of the sewer has also identified multiple sags throughout its entire length. Therefore, it is likely that special provisions would be required in the design of a replacement sewer to ensure that settlement does not occur during and after construction. However, at this time, the location and extent of where poor soil conditions exist along the existing sewer on Rustcraft Road can not be determined. Without this information, it is difficult to estimate the cost associated with construction of a new gravity replacement sewer for comparison purposes.

As noted in Section Three of this report, the existing sewer is constructed at an average slope of 0.0018 which is below the minimum slope of 0.0022 recommended for 12-inch pipe. Although it may be possible to increase the slope of the existing sewer by connecting directly to the EBRI, which is approximately 1.5 feet lower, there would be no significant improvement in the depth of cover provided for the sewer over its entire length of approximately 4,150 feet. Based on record plan information, there are sections of the existing sewer that have less than two feet of cover. New sewers located in paved roadways are generally designed with seven feet of cover, with a minimum of six feet typically required.

Finally, based on review of the TV inspection logs and videotapes, there do not appear to be any service connections to the existing sewer between the sewer connection from the Allied Drive easement and Central Avenue, a distance of approximately 2,520 feet. Further, there is limited opportunity for additional development to occur between these two points. As a result, it may be possible to construct a pump station in the vicinity of the Allied Drive easement that would convey flow from all upstream points to Central Avenue. This would include the flow from a proposed 300-unit apartment project referred to as "Jefferson at Dedham," that has been submitted by JPI Apartment Development to the town's Zoning Board of Appeals for approval under the State's Chapter 40B Affordable Housing Zoning Law. More importantly, however, the construction of a pressure force main would eliminate many of the settlement concerns associated with constructing a gravity sewer where the potential for poor soil conditions exists. This is primarily due to the fact that a force main would be constructed at a shallow depth and with flexible joints that can bend in response to slight movements in the soils. As long as a minimum depth of cover of five feet is provided together with appurtenant structures for solids blow-off and air release at the low and high points of the system, a force main may be able to be installed between these two points without having to provide special support measures that would likely be required in the construction of a new gravity replacement sewer.

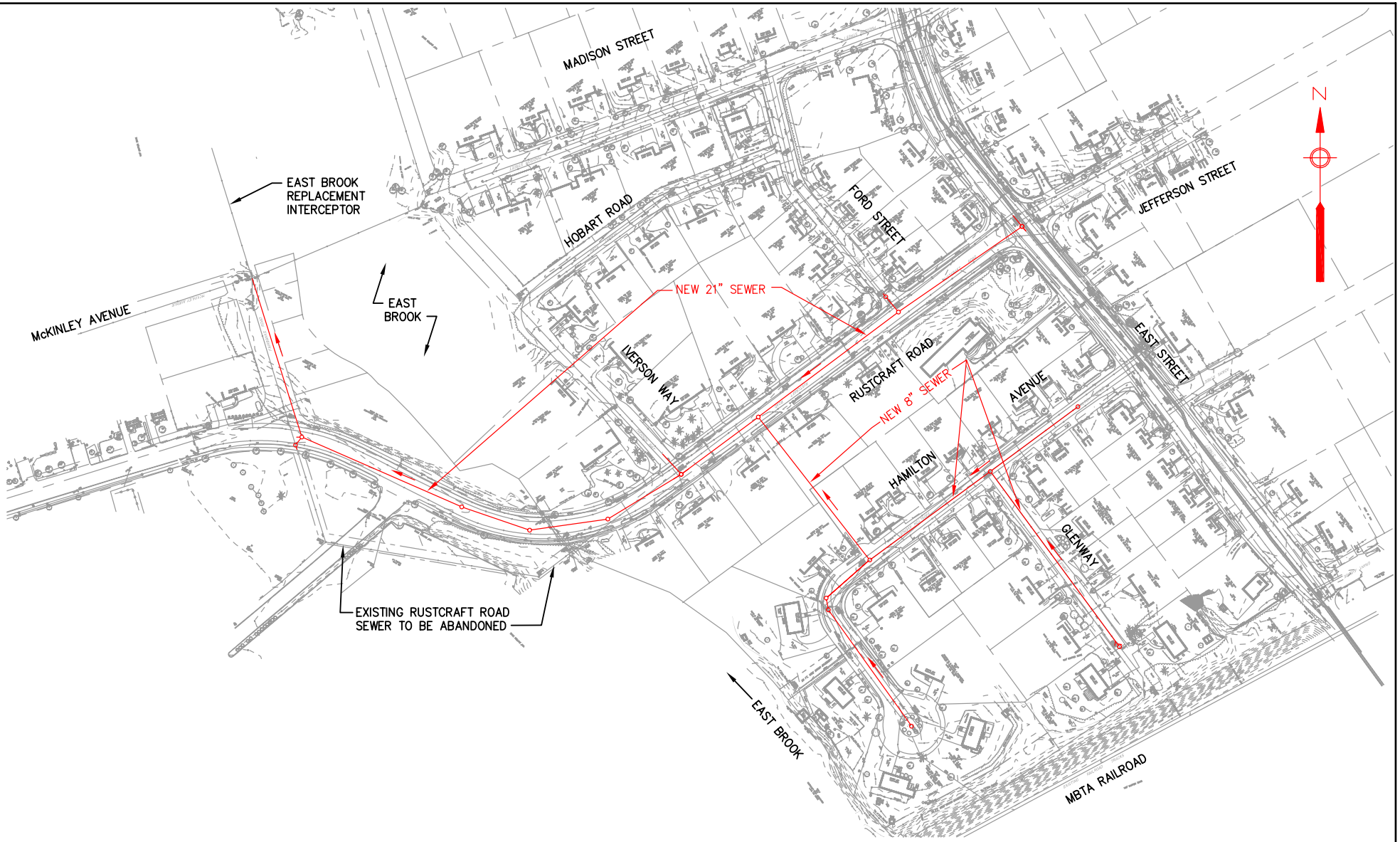
In light of the considerations above, it is recommended that the town conduct a preliminary design study to evaluate the impacts and costs associated with construction of a new gravity replacement sewer versus a new pump station and force main. As a first step to evaluating these alternatives, a subsurface exploration program should be conducted to determine the location and extent of poor soil conditions. This information would be used together with the existing survey data that is already available for the project to develop conceptual plans for constructing either a replacement sewer or a pump station. These plans would serve as the basis for estimating the capital and annual O&M costs of each alternative. A preliminary design report would then be prepared for the town's review and approval. This report would identify a recommended plan and outline the costs associated with the final design, permitting, and construction of the project. For budgeting purposes, the town should establish a budget allowance of $40,000 to complete the study outlined above.

Rustcraft Road, East Street and Glenway/Hamilton Avenue Sewers

Prior to the start of this study, it was assumed that under the worst case scenario, a combination of new gravity sewers and a small pump station and force main could be constructed to eliminate overflows in the Glenway/Hamilton Avenue area. Following review of the field survey data collected during this study, however, it was determined that an all gravity system is feasible. Figure 4-3 shows the conceptual layout of the proposed new gravity system which includes construction of approximately 1,465 feet of 21-inch sewer on Rustcraft Road, and 1,275 feet of 8-inch sewer on Glenway and Hamilton Avenue. The proposed 21-inch sewer on Rustcraft Road would start at the terminus of the EBRI and run along Rustcraft Road to East Street. The new sewer would be constructed from 6 to 13 feet deep at a minimum slope of 0.001. This would increase the existing flow capacity in this line section by approximately 1.5 mgd. The new sewer would also be constructed approximately 1.5 feet deeper than the existing sewer to allow gravity connection from Glenway and Hamilton Avenue via a new sewer located in a cross-country easement.

The new sewers on Glenway and Hamilton Avenue would be constructed from 5 to 12 feet deep at a minimum slope of 0.004. This would provide approximately 4.5 feet of cover for the 8-inch sewer at the end of Glenway. Currently, the existing sewer has less than 12 inches of cover and is also the lowest point in the system. As a result, the existing sewer on Glenway is often subject to sanitary sewer overflows whenever surcharging occurs in the downstream sewer on Rustcraft Road during wet weather conditions.

The total estimated construction cost for the proposed new sewers, including an allowance for engineering and contingencies, is approximately $975,000. This does not include the costs for obtaining easements or providing police details during construction. As noted throughout this report, the town has already retained the services of Metcalf & Eddy to design the proposed new sewers. At this time, it is anticipated that construction of this project will start in the summer of 2003.



Metcalf & Eddy

TOWN OF DEDHAM, MASSACHUSETTS

FIGURE 4–3 PROPOSED SEWERS FOR GLENWAY/HAMILTON AVE. AREA

SCALE: NTS	4/28/03	CPB	SK 4–3

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SECTION FIVE
IMPLEMENTATION PROGRAM

In the preceding sections of this report, specific recommendations have been made to address issues related to sewer defects, I/I, and sanitary sewer overflows and system back-ups within the Glenway/Hamilton Avenue study area. This section presents a summary of the recommendations, including the costs, funding, schedule, and legal and institutional issues associated with their implementation.

RECOMMENDED PLAN

The recommended plan for the Glenway/Hamilton Avenue study area consists of four components: sewer pipeline rehabilitation, sewer capacity improvements, town-wide program addressing private inflow sources, and routine operation and maintenance procedures for priority sewers within the study area. Table 5-1 presents a summary of the estimated capital costs for all components of the recommended program. The estimated costs are based on current construction prices and engineering costs as of May 2003, and are referenced to an Engineering News Record (ENR) Construction Cost Index of 6642. With the exception of the costs for the sewer replacement on Rustcraft Road, Glenway, and Hamilton Avenue, the costs presented in this table are planning level cost estimates for budgeting purposes only. A more accurate estimate of the anticipated construction costs may be determined during the design phase(s) of the recommended program.

Sewer Pipeline Rehabilitation

This component is divided into three categories: sewer pipeline rehabilitation utilizing trenchless technologies, sewer replacement, and rehabilitation of service laterals. Sewer pipeline rehabilitation utilizing trenchless technologies generally includes root control, joint testing and chemical sealing, spot repair of structural defects, and sewer relining. The total estimated cost of these sewer pipeline repairs is approximately $1,149,000.

TABLE 5-1. SUMMARY OF ESTIMATED COSTS

Component	Total Estimated Cost
Sewer Pipeline Rehabilitation	
• Sewer Rehabilitation Utilizing Trenchless Technology	$1,149,000
• Sewer Replacement	$872,000
Lateral Service Connection Rehabilitation	
• Cutting and/or Sealing and Testing	$164,000
• Dig and Replace	$114,000
Sewer Capacity Improvements	
• Design Study of Rustcraft Road (Elm to McKinley Street)	$40,000
• Construction of New Sewers (Rustcraft Road, Glenway and Hamilton Avenue)	$975,000
Removal of Private Inflow Sources	N/C
Routine O&M	N/C
Total	$3,314,000

Sewer replacement is recommended for approximately 2,970 feet of sewers with a total estimated cost of approximately $872,000. This work is exclusive of the recommended improvements to address sewer capacity problems discussed later in this section.

Service lateral rehabilitation is recommended for approximately 120 services. Rehabilitation of service laterals includes cutting, sealing and testing, or digging and replacing. It is recommended that the cutting, sealing and testing of services be included as part of the trenchless sewer pipeline rehabilitation work. The total estimated cost for this work is approximately $164,000. It is also recommended that services requiring replacement be included as part of the sewer replacement work. The total estimated cost for replacing services is approximately $114,000.

It is anticipated that the funding required to implement the sewer pipeline rehabilitation program outlined above would be generated from the annual assessment of $500,000 that is added to the sewer rate by the town. This assessment was approved at 2001 Spring Town Meeting for this purpose. To date, the town has used these funds to continue with an annual program of TV inspecting sewers as well as to complete a sewer rehabilitation contract for sewers identified as having high infiltration rates. Based on discussions with town personnel, there is approximately $530,000 available for the construction of I/I rehabilitation measures. However, it should also be

noted that a portion of this funding is already committed to miscellaneous repairs to the system, such as the extension of the existing sewer on Wentworth Street to collect sanitary flow from the town-owned Endicott Estate building.

Since the total cost of the sewer pipeline rehabilitation program exceeds the funding currently available, a phased approach is proposed. This would entail initiating the design of two separate contracts for sewer rehabilitation utilizing trenchless technologies and traditional dig and replacement methods of construction. As additional funding becomes available from one year to the next, the town would then bid the contracts for construction.

Sewer Capacity Improvements

The existing sewer on Rustcraft Road going in either direction from the terminus of the East Brook Replacement Interceptor (EBRI) toward Elm Street or East Street is subject to flow related problems. To address the portion of the Rustcraft Road sewer between the EBRI and Elm Street, it is recommended that the town conduct a preliminary design study to evaluate the impacts and costs associated with construction of a new gravity replacement sewer versus a pump station and force main. The total estimated cost of this study is approximately $40,000.

It is anticipated that the funding to conduct this study would be obtained from the various fees to be paid by JPI Apartment Development for the proposed “Dedham at Jefferson” project. As of this writing, the town is negotiating the total fees to be paid by the developer. However, at a minimum, the developer would be required to pay $150,000 in sewer connection fees for the proposed 300-unit apartment complex and $64,000 in I/I mitigation fees.

To address the portion of the Rustcraft Road sewer between the EBRI and East Street, it is recommended that the town proceed with the bidding and construction of new sewers along Rustcraft Road, Glenway, and Hamilton Avenue. The total estimated cost of this project, including an allowance for engineering and contingencies, is approximately $975,000.

Although the design of this project is essentially completed, the town must file a Notice of Intent (NOI) application with the local Conservation Commission and obtain permanent easements from two property owners prior to the start of construction. A NOI is required since there are several resource areas that would likely be impacted during construction. The first resource area is the wetland in the easement between McKinley Avenue and Rustcraft Road. The second resource area is the land under water where the proposed new sewer will cross under the existing culvert on Rustcraft Road. It should be noted that the town also intends to replace the existing culvert with a new box culvert as part of this project. However, the design of drainage improvements for Rustcraft Road and Glenway and Hamilton Avenue is being prepared by others. The last resource area that would be impacted is the East Brook where the outfall for the existing drain on Hamilton Avenue discharges. This outfall is scheduled to be replaced along with the existing drains on Glenway and Hamilton Avenue as part of the aforementioned drainage improvements being designed by others.

The majority of the proposed new sewers would be constructed within existing rights-of-way or easements owned by the town. However, in order to lower the grade of the existing sewers on Glenway and Hamilton Avenue, two new easements would be required from the property owners at 35 Hamilton Avenue and 36 Rustcraft Road. By obtaining these easements, the new sewer on Hamilton Avenue would run cross-country to the proposed new replacement sewer on Rustcraft Road as opposed to running out to East Street similar to the layout of the existing sewer. This change in flow direction, in combination with the increased depth of the proposed new sewer on Rustcraft Road, would provide approximately 4.5 feet of cover for the new sewer at the end of Glenway. As noted previously in Section Four of this report, the existing sewer has less than 12 inches of cover and is also the lowest point in the system. As a result, it is often subject to sanitary sewer overflows whenever surcharging occurs in the downstream sewer on Rustcraft Road during wet weather conditions.

The funding for this project has already been approved by the town through a Proposition 2-½ Override Vote conducted in June 2001. By way of this vote, the town is authorized to borrow up to $2.5 million for this project which includes improvements to both sanitary sewers and storm drains as well as roadway reconstruction.

Private Inflow Sources

It is recommended that the town develop an inflow reduction plan to address private sources of inflow such as sump pumps, roof leaders, and yard/driveway drains. To implement such a program, however, the town must first determine how the program would be funded. This is often a sensitive issue due to the fact that most municipalities have ordinances stating that private inflow sources are prohibited and the homeowner is normally responsible for removing the source at his/her own expense. However, enforcement of these provisions is often difficult to implement on a voluntary basis.

Another issue that is often raised with respect to private inflow source removal is ownership of the service lateral connection. In some communities, the homeowner is responsible for the entire length of the service lateral connection, while in other communities, the homeowner is only responsible for the service lateral connection from the house to the property line. And, in rare instances, the homeowner is not responsible for the service lateral connection at all.

As a first step, therefore, the town should organize an advisory group of town officials and residents to conduct a workshop meeting to discuss the various programs that have been used throughout the state. For example, in Amesbury and Burlington, Massachusetts, the removal of inflow sources is performed solely by developers seeking to obtain sewer connection permits and at no cost to the town. Both of these communities are under sewer moratoriums and are required to remove I/I at either a 5:1 or 10:1 ratio prior to receiving wastewater flow credit from the Massachusetts DEP. The provision of wastewater flow credit is administered through a Sewer Bank, with each town responsible for maintaining a positive flow balance.

In other Massachusetts communities, the cost to remove private inflow sources has been shared between the homeowner and the municipality. This type of program requires the municipality to take a more active role in the process, and there are advantages and disadvantages that need to be carefully considered before implementing such a program. For these reasons, the town would benefit greatly from having an open forum discussion of the different types of private inflow source removal programs that have been implemented state-wide.

Following the workshop meeting, the town should then develop an inflow reduction plan that meets the goals and objectives as determined by the advisory group. As part of this effort, the town should review its existing ordinances to ensure that the legal authority to implement the program is in place. The town should also sponsor public participation activities, including the preparation of a brochure to mail to residents, posting the brochure on the town's web site, and conducting a series of public meetings to inform residents of the program. Finally, the town should develop a standard set of details to specify the appropriate methods for redirecting private sources of inflow.

Routine O&M Procedures

As noted previously in Table 2-3 of this report, there are a number of sewers that were identified as requiring moderate/heavy cleaning prior to TV inspection. Further, as noted in Tables 3-1 through 3-4 of this report, there are many sewers located throughout the study area that were constructed at slopes less than the minimum typically used in the design of sanitary sewers. To minimize the potential for flow related problems to occur within these sewers, it is recommended that the town implement a program of cleaning the sewers and inspecting the manholes for evidence of surcharging on a regular basis. As a first step, the town should schedule this work to be performed on an annual basis. The schedule may then be adjusted accordingly based on the findings of the first several rounds of cleaning and inspection.

As recommended in previous reports, the town should also take the necessary steps to locate and inspect any missing or buried manholes where information indicates that such a manhole exists. In addition, the town should provide and maintain access to all the sewers in cross-country easements. This may involve the construction of access roads through easements and/or periodically clearing and grubbing the vegetated growth within the sewer easement. By providing access to these sewers, the town would be more prepared to handle an emergency situation should a problem occur.